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The Limnological Characteristics of the Bow, Oldman and South Saskatchewan Rivers
(1979

Alberta
ENVIRONMENT
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Pollution Control Division
Water Quality Control Branch

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THE LIMNOLOGICAL CHARACTERISTICS OF THE BOW, OLDMAN AND SOUTH SASKATCHEWAN RIVERS (1979 - 82)

PART I

NUTRIENT AND WATER CHEMISTRY

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EXECUTIVE SUMMARY

The objective of the research was to analyze nutrient and water chemistry in the Bow, Oldman and South Saskatchewan Rivers from May, 1979 to April, 1982. Particular emphasis was placed on phosphorus origins, budgets, and dynamics.

Water chemistry throughout the Basin showed typical seasonal changes related to climate, discharge and biological activity. In winter, climatological and physical factors controlled biological activity. In summer, climatological and physical factors were optimum for biological activity.

Conductivity, alkalinity, dissolved inorganic carbon, nitrogen and phosphorus were high in winter when temperature and pH were low. The opposite trend was shown in summer.

The spring high flow period had the greatest concentrations of particulate matter and turbidity. The Bow River, with its more regulated discharge, showed less extremes of particulate related variables than the other two rivers.

Dissolved phosphorus was the component of total phosphorus most available to biological systems. This form was used in Part II to develop functional relationships between phosphorus and aquatic plant and algal growth. In 1980 and 1981, city sewage treatment plants contributed 89% of the dissolved phosphorus input to the study area (70% from Calgary, 14% from Lethbridge and 5% from Medicine Hat).

Calgary contributed 91% of the dissolved phosphorus to the Bow River, Lethbridge contributed 78% to the Oldman River, and Medicine Hat contributed 12% to the South Saskatchewan River.

Phosphorus from sediments, from industry and from irrigation activities was not a major source contributing to plant growth.

Dissolved phosphorus was depleted most rapidly by plant growth in the Bow River downstream of Calgary. Low dissolved phosphorus was not the limiting factor for plant growth until the site at Bassano. Dissolved phosphorus was the nutrient-limiting factor for plant growth for the remainder of the Basin. The possible exception was the short periods of nitrogen limitation in the Oldman River downstream of Lethbridge.

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1.0 INTRODUCTION

The purposes of the South Saskatchewan River Basin Limnological Study included the examination of the present state of the rivers; the development of relationships between plant growth and nutrients to determine the current response of the river to nutrients; and the development of phosphorus budgets for the Basin including inputs, storage, bioavailability, cycling dynamics and outputs.

This report deals strictly with water chemistry data, in particular, nutrient chemistry and loadings. The relationship between aquatic plant growth, nutrient levels and physical variables will be addressed in a separate report (Part II. The Primary Producers; Charlton et al., 1986).

The extensive information collected by regular sampling during the study (May, 1979 to April, 1982) forms the core of the water chemistry study. These data will be used to describe the conditions throughout the Basin as they change with seasons and sites. They also provide a basis for calculation of phosphorus loadings at different sites on the river. The results can be used, in turn, to determine changes within each reach of the river.

Loadings analysis has been used widely in eutrophication research on lakes to determine the relationship between phosphorus and primary production (Dillon, 1975a; Vollenweider, 1975; 1976; Jones and Lee, 1982) and is useful as a predictive management tool (Dillon, 1975b; Cross, 1978). Its application to rivers has been much less extensive, but provides a basis for study of river eutrophication (Peters, 1973; Hill, 1982; Brown et al., 1982).

Other sources of data were used to qualify and expand on the information derived from the core study. Dissolved oxygen and temperature, for example, were monitored by Alberta Environment remote continuous monitors at several locations within the Basin. The results provide a more comprehensive data base for these parameters. Similarly, daily discharges were monitored by Water Survey of Canada at a number of sites. Additional monthly water chemistry data were available from the Water Quality Branch, Environment Canada. These data, information from various tributary and irrigation return flow studies, sediment studies, stormwater studies, routine collections from sewage treatment plants, and industrial effluents were used to supplement the core data collection when defining the conditions in the Basin.

Water quality and discharge data have been collected in the South Saskatchewan River Basin for many years. This historical information provides a basis for comparison with data collected during the present study period. City of Calgary sewage treatment plant data were reviewed and an estimate of the relative impact on the receiving river of the sewage from Calgary, Lethbridge and Medicine Hat was made for the period from 1971 to 1981.

Phosphorus is generally considered to be the nutrient which limits or controls aquatic plant growth, although nitrogen has also been shown to have some influence (Wetzel, 1975). The ratio of nitrogen to phosphorus concentration, which indicates the relative supply of these nutrients, has been used to investigate nutrient limitation (Sakamoto, 1966; Schindler, 1976; Cross, 1978). However, absolute concentrations of each nutrient must also be considered.

Data collected during the study was used to determine which nutrient controlled plant growth.

Considerable controversy exists over the bioavailability of various forms of phosphorus (Paerl and Downes, 1978; Lee et al., 1980). An investigation of phosphorus bioavailability in the Basin will define which nutrient form to use in predictive relationships with plant growth.

The portion of the Bow River located between Calgary and Carseland shows the most dramatic impact of nutrients on the river system. The Bonnybrook study provides a more detailed look at the river in this one region. The nutrients entered the river at the right bank from Bonnybrook, the major sewage treatment plant, and at midstream from the Fish Creek sewage treatment plant. The gradient of nutrient concentrations downstream from the Bonnybrook plant provides natural experimental conditions for studying nutrient concentrations and primary producers within the mixing zone at varying concentrations.

2.0 METHODS

2.1 Water Chemistry

Acid washed sample bottles were obtained from the Water Quality Lab of Environment Canada in Calgary. Grab subsurface samples were collected into polyethylene and sovirel bottles, filtered and kept cool while being transported back to the lab for analysis, using standard lab techniques (Table 1).

Thirteen sites were chosen for water chemistry sampling in the South Saskatchewan River Basin (Figure 1). Six of these sites were located on the Bow River, three were on the Oldman River and four on the South Saskatchewan River. The locations of several sites were changed during the study. A summary of station locations is given in Table 2.

Standard Water Quality Control Branch sampling techniques were employed. During the open water season, samples were collected either by wading into the river, or by lowering a bucket from a bridge. Methods varied at each site and throughout the year depending primarily on river discharge and access. Winter samples were collected either through a hole drilled in the ice, or at a flowing open lead if it was accessible. However, sampling methods differed at Sites 2 and 10. After January, 1980, Site 2, on the Bow River at Stiers Ranch, was sampled from the monitor's intake water pipe. During the period from May, 1979, to March, 1980, Site 10, on the South Saskatchewan River above Medicine Hat, was sampled from the monitor's intake water pipe.

TABLE I SAMPLING BOTTLE, ANALYTICAL METHOD, MEASUREMENT UNIT AND NAQUADAT CODES FOR WATER CHEMISTRY VARIABLES

Variable	NAQUADAT* Code	Analytical Method	Units	Sample** Bottle
Conductivity	02041L or S	conductivity meter	U Sie/cm	n/a
Temperature	02061S	mercury thermometer	°C	n/a
Turbidity	02073L	turbidimeter	JTU	1L poly
Dissolved Organic C (DOC)	06104L or D	infrared analysis, 0.45 u membrane filter	mg/L	2 oz poly
	06106L or D	as above, GFC filter	mg/L	2 oz poly
Dissolved Inorganic C (DIC)	06152L or D	infrared analysis, 0.45 u membrane filter	mg/L	2 oz poly
	06153L or D	as above, GFC filter	mg/L	2 oz poly
Particulate Organic C (POC)	06902L or D	thermal conductivity, CHN analyzer	mg/L	1L poly
Nitrate-Nitrite N (NIT)	07110L or D	colourimetry on autoanalyzer, 0.45 u membrane filter	mg/L	2 oz poly
	07119L or D	as above, GFC filter	mg/L	2 oz poly
Ammonia N (NH_3)	07506L	ion selective electrode	mg/L	500 mL poly
Dissolved N (DN)	07651L or D	UV digestion, colourimetry on autoanalyzer, 0.45 u membrane filter	mg/L	2 oz poly
	07661L or D	as above, GFC filter	mg/L	2 oz poly
Particulate N (PN)	07902L or D	thermal conductivity, CHN analyzer	mg/L	1L poly
Alkalinity-Total ($CaCO_3$)	10106L or 01L	infrared analysis	mg/L	1L poly
Alkalinity-Phenolphthalein	10151L	potentiometric filtration	mg/L	1L poly
pH	10301L	electrometric	pH units	1L poly
Residue - Non-filterable (NFR)	10401L	gravimetric	mg/L	1L poly
Residue - Non-filterable, fixed (NFFR)	10501L	gravimetric	mg/L	1L poly
Silica - Reactive (Si)	14105L	colourimetry using heteropoly blue method on autoanalyzer	mg/L	1L poly
Dissolved P (DP)	15103L or D	colourimetry on autoanalyzer, 0.45 u membrane filter	mg/L	45 mL sov
	15113L or D	as above, GFC filter	mg/L	45 mL sov
Dissolved Reactive P (OP)	15256L or D	colourimetry on autoanalyzer, 0.45 u membrane filter	mg/L	2 oz poly
	15266L or D	as above, GFC filter	mg/L	2 oz poly
Total Inorganic P (TIP)	15301L	colourimetry on autoanalyzer	mg/L	45 mL sov
Dissolved Inorganic P (DIP)	15356L or D	colourimetry on autoanalyzer, 0.45 u membrane filter	mg/L	45 mL sov
	15346L or D	as above, GFC filter	mg/L	45 mL sov
Total P (TP)	15406L	colourimetry on autoanalyzer	mg/L	45 mL sov
Dissolved Chloride (Cl)	17206L	colourimetry on autoanalyzer	mg/L	

* L - lab filtered (where applicable)
D - field filtered
S - site analysis

** - filtered samples collected first in 1 or 2L poly bottle
- sovirel samples transferred from 1 or 2L poly bottles during winter

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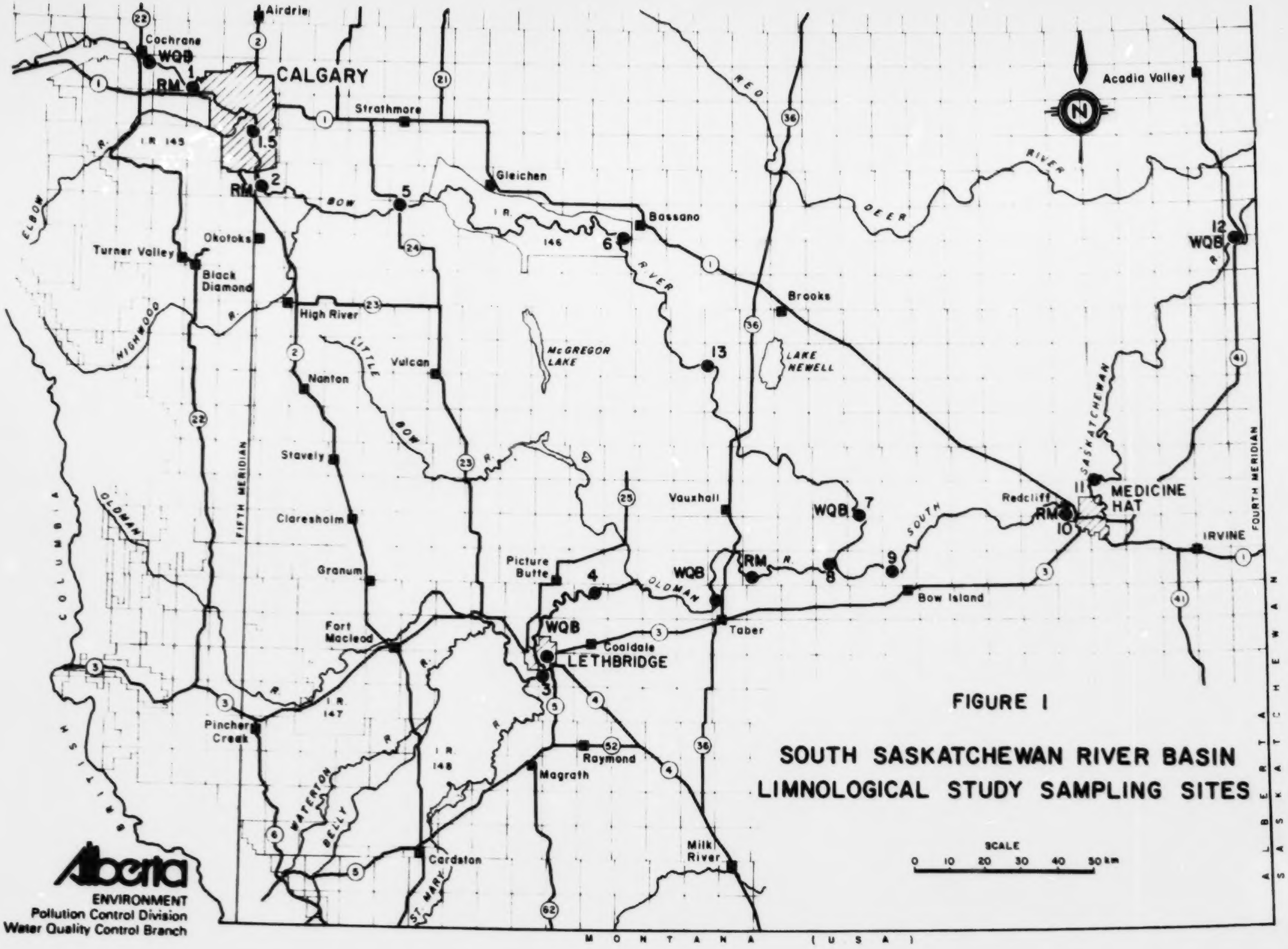
Airdrie
Cochrane
WQB
1
RM
CALGARY
Strathmore
1.5
2
RM
I.R. 145
ELBOW
R.
BOW
5
Gleichen
I.R.
146
Bassano
6
RIVER
RED
DEER
RIVER
Acadia Valley
N
12
WQB
R.
Okotoks
Turner Valley
Black Diamond
R.
High River
HIGHWOOD
LITTLE
BOW
R.
Vulcan
Nanton
Stavely
Claresholm
Granum
Fort Macleod
McGREGOR LAKE
13
Brooks
LAKE NEWELL
SASKATCHEWAN
11
MEDICINE HAT
Redcliff
RM
10
IRVINE
FOURTH MERIDIAN
FIFTH MERIDIAN
Vauxhall
WQB
7
SOUTH
9
8
RM
R.
WQB
OLDMAN
Picture Butte
4
WQB
Coaldale
LETHBRIDGE
3
Taber
Bow Island
COLUMBIA
BRITISH
OLDMAN
R.
Pincher Creek
I.R.
147
I.R.
148
WATERTON
BELLY
ST. MARY
Magrath
Raymond
Cardston
Milk River
MONTANA (U.S.A.)
ALBERTA
SASKATCHEWAN
SCALE
0 10 20 30 40 50 km
1
2
3
4
5
6
21
22
23
24
25
36
41
52
62

FIGURE I

SOUTH SASKATCHEWAN RIVER BASIN LIMNOLOGICAL STUDY SAMPLING SITES

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TABLE 2 SITE LOCATIONS AND NAQUADAT CODES FOR WATER CHEMISTRY SAMPLING IN THE SOUTH SASKATCHEWAN RIVER BASIN

Site	Km	Code	Location
1	5	00AT05BH2105	Bow River at 85th Street Bridge, Calgary
	0	00AT05BH2090	Bow River below Bearspaw Dam (from 10/03/80)
2	34	00AT05BM2161	Bow River at Highway 22X, Calgary
	37	00AT05BM2160	Bow River at Stiers Ranch, Calgary (from 22/01/80)
5	79	00AT05BM2215	Bow River below Carseland Weir
6	195	00AT05BM2240	Bow River below Bassano Dam
13	256	00AT05BN2245	Bow River at Bow City Bridge (from 24/09/79)
7	346	00AT05BN2270	Bow River at Ronalane Bridge
3	208	00AT05AD2035	Oldman River at Highway #3, Above Lethbridge
4	251	00AT05AD2050	Oldman River at Highway #845, Below Lethbridge
8	364	00AT05AG2095	Oldman River at the Mouth (Confluence with the Bow River)
9	382	00AT05AK2070	South Saskatchewan River at Highway #879
10	467	00AT05AK2080	South Saskatchewan River above Medicine Hat
11	499	00AT05AK2085	South Saskatchewan River below Medicine Hat
	501	00AT05AK2087	South Saskatchewan River below Medicine Hat (from 31/03/80)
12	624	00AT05AK2090	South Saskatchewan River at Highway #41

Duplicate samples were collected from May, 1979, to May 1980. Filtered variables were provided from filtrate collected through a 0.45 µ membrane filter for one sample and through a GFC filter for the duplicate. For numerous reasons, the number of samples collected was changed at this time. Starting in June, 1980, single samples were taken with one duplicate per 20 samples. Nucleopore membrane filters were used from May, 1979 till April, 1980. Sartorius membrane filters were then used from May, 1980, till the end of the project in May, 1982. Filtrate collected through a 0.45 µ Sartorius membrane filter provided the filtered variables except for dissolved nitrogen. Dissolved nitrogen was taken from the GFC filtrate from particulate nitrogen and particulate organic carbon analysis to ensure accurate calculation of total nitrogen.

The samples were collected onto ice and were generally field filtered within 16 hours of sampling. However, from November 1979 to June 1980 samples were returned to the lab for filtration, generally within 24-48 hours, but always within 60 hours.

For the first two years (May, 1979, to May, 1981), water samples were taken once every two weeks in the periods May to August, 1979, March to November, 1980, and March to May, 1981. Otherwise, samples were collected once in three weeks. In the third year, from June, 1981, to April, 1982, samples were collected once in three weeks from the Bow and Oldman River sites. Samples from the four South Saskatchewan River sites were taken once in six weeks (Sites 9 and 11 were sampled alternatively with Sites 10 and 12 at three week intervals).

The development of any routine sampling program requires a review of technical considerations related to analytical as well as sampling methods. Three studies, which were carried out to address several of these concerns, are reported in Appendix A.

For statistical purposes, seasonal definition at all 13 sites was based on three years of water chemistry and discharge data, and 20 months of benthic algal data. The dates of seasonal transition were chosen to avoid splitting of water chemistry sampling runs, thus making seasonal site means more comparable. Spring was defined as the period from March 20 to June 19, summer from June 20 to September 14, fall from September 15 to December 1 and winter from December 2 to March 19.

Seasonal and annual means were compiled using NAQUADAT (National Water Quality Data Bank) report formats, which give arithmetic averages of data. That is, when summer data from three years were combined, no attempt was made to weight each summer average equally. Similarly, annual averages are simply the average of all data collected during the study.

Pearson's correlations (SPSS) were calculated on a number of raw data sets to determine the strength of the relationship between different variables. Kruskal-Wallis anova tests and Mann-Whitney U tests were used to test for seasonal and yearly differences in selected variables.

2.2 Other Routine Data

Dissolved oxygen and temperature were measured by remote monitors on a continuous basis throughout the study: on the Bow River above Calgary at Baker Sanatorium and below Calgary at Stiers Ranch (from February 1980); on the Oldman River at Fincastle; and on the South Saskatchewan River at Medicine Hat (Figure 1). Diurnal curves of dissolved oxygen and temperature were generated from these data and compared among sites and seasons.

Water Survey of Canada measures of discharge at 47 stations in the South Saskatchewan River Basin were used directly in the study. Seven of the stations were on the main rivers. The remaining stations were on tributary streams, irrigation canals and return flows (Table 3). These data were used to calculate discharge at each regular sampling site and at other locations relevant to phosphorus input inventories. When discharge measurement stations were not at the same collecting sites as water chemistry sites, discharge was calculated according to the equations given in Table 4. The Water Quality Branch of Environment Canada under contract to Alberta Environment collects water chemistry data from five sites on the main rivers within the study area (Figure 1, Table 3). These data were used to supplement our data.

2.3 Historical

The most complete historical records of discharge, from 1900 to the present, are at Calgary on the Bow River, near Lethbridge on the Oldman River, and at Medicine Hat on the South Saskatchewan River.

TABLE 3 LOCATION OF WATER SURVEY OF CANADA DISCHARGE MEASUREMENT STATIONS RELATIVE TO WATER CHEMISTRY STUDY SITES IN THE SOUTH SASKATCHEWAN RIVER BASIN

Station	Site	Location
		BOW RIVER
05BH004	1	Bow River at Calgary
05BJ001		Elbow River below Glenmore Dam
05BH003		Nose Creek at Calgary
05BM003		Western Irrigation District Canal near Chestermere Lake
05BK001	2	Fish Creek near Priddis
05BL024		Highwood River near Mouth
05BM009		Twelve Mile Coulee Spillway near Carseland
05AC004		Bow River Development Main Canal
05BM002	5	Bow River below Carseland Dam
05BM005		Hammer Hill Spillway near Gleichen
05BM012		Cairn Hill Spillway near the Mouth
05BM014		West Arrowwood Creek near Arrowwood
05AC004		Bow River Development Main Canal
05BM008		Crowfoot Creek near Cluny
05CJ001		Eastern Irrigation District North Branch Canal near Bassano
05CJ003		Eastern Irrigation District East Branch Canal near Lathom
05CJ004		Eastern Irrigation District Springhill Canal near Lathom
05BM004	6	Bow River below Bassano Dam
05BN014	13	Coal Creek at Bow City
05BN010		Antelope Coulee Spillway
05BN024		Natural Flow C near Bow City
05BN009		Bow River Development Drain K near Vauxhall
05BN006		New West Coulee near Mouth
05BN023		Bow River Development Drain E near Vauxhall
05BN008		Bow River Development Drain D near Vauxhall

TABLE 3 CONT'D

Station	Site	Location
05BN015		Rolling Hills Canal No. 1 Spill
05BN002		Twelve Mile Creek near Cecil
05BN019		Rolling Hills Canal No. 2 Spill
05BN012	7	Bow River near the Mouth
05BN007		Ronalane Wasteway near Hays
05AG005		Bow River Development Drain A near Hays
		OLDMAN RIVER
05AD007	3	Oldman River near Lethbridge
05AD037	4	Piyami Drain near Picture Butte
05AD038		Battersea Drain near the Mouth
05AC023		Little Bow River near the Mouth
05AG007		Lateral 10 Spillway near Chin
05AG008		Bountiful Coulee near Cranford
05AG026		Bountiful Coulee Inflow near Cranford
05AG023		Drain T-2 near Taber
05AG003		Expanse Coulee near the Mouth
05AG025		Drain T-11 near Fincastle
05AG005	8	Bow River Development Drain T near Hays
		SOUTH SASKATCHEWAN RIVER
05AJ002	9	Drain S-4 near Grassy Lake
05AJ003		Drain S-10 near Bow Island
05AJ001	10	South Saskatchewan River at Medicine Hat
05AH005	11	Seven Persons Creek at Medicine Hat
05AK001	12	South Saskatchewan River at Highway No. 41

TABLE 4 EQUATIONS USED IN THE CALCULATION OF DISCHARGE AT WATER CHEMISTRY SITES WHICH DID NOT COINCIDE WITH DISCHARGE MEASUREMENT STATIONS

Site	Equation
2	$\frac{(\text{Site 1} + \text{4 d/s inputs}) + (\text{Site 5} - \text{3 u/s inputs})}{2}$
5*	Site 2 + 3 d/s inputs
6*	$\text{Site 5} + (\text{Site 7} - \text{Site 5}) \times \frac{117}{267}$
13	$\text{Site 7} - (\text{Site 7} - \text{Site 5}) \times \frac{90}{267}$
4	Site 3 + 1 d/s input
8	$\frac{(\text{Site 4} + \text{9 d/s inputs}) + (\text{Site 9} - \text{4 u/s inputs})}{2}$
9	Site 10 - 1 u/s input
11	$\frac{(\text{Site 10} + \text{1 d/s input}) + (\text{Site 12})}{2}$

*required in winter

u/s - upstream
d/s - downstream

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Historical nutrient data were compiled from January 1970 to April 1979 using the NAQUADAT summary and seasonal summary report formats from both provincial and federal data bases.

2.4 Biologically-Available Phosphorus/Algal Assay

Phosphorus is found in particulate as well as dissolved fractions, and the dissolved fraction is measured in various chemical forms. There is considerable controversy over the techniques for measuring these forms (Rigler, 1966; Lean, 1973; Downes and Paerl, 1978; Stainton, 1980) and their bioavailability (Paerl and Downes, 1978; Lee et al., 1980). Therefore, measurements of dissolved and particulate bioavailable phosphorus were made using algal assay techniques to compare with chemical analyses.

Samples for biologically-available phosphorus analysis were collected on regular sampling trips. GFC filtered and whole water samples for dissolved biologically-available phosphorus and particulate biologically-available phosphorus analyses, respectively, were held on ice prior to initiation of the assay. Sample handling time after filtration in the field was usually 72 hours or less.

The algal assay technique was adapted from the USEPA bottle test for static bioassays (Miller et al., 1978) by Hamilton et al. (1981). Selenastrum capricornutum was used as the test alga. Triplicate bioassays were run on membrane filtered (0.45 µ) samples. Samples were spiked with sodium nitrate to ensure that no nitrogen limitation occurred.

The treatment of particulate samples for analysis was a modification of the technique of Cowen and Lee (1976). The method is given in detail in Hamilton et al. (1981). Mean values of dissolved biologically-available phosphorus and particulate biologically-available phosphorus were calculated from three values except when final cell density of one replicate was inordinately different from the other two.

Correlation analysis and paired student's t-tests were used to evaluate the relationship between dissolved biologically-available phosphorus and dissolved reactive phosphorus, dissolved inorganic phosphorus and dissolved phosphorus.

Algal growth potential was measured using the same technique as dissolved biologically-available phosphorus with the one exception that no nitrogen spiking was used.

A limited number of measurements of orthophosphate concentrations were obtained using Sephadex-gel filtration techniques. Comparison of these results with corresponding chemical data for dissolved reactive phosphorus would test the degree of interference from labile, high-molecular-weight organic phosphorus compounds (Downes and Paerl, 1978).

Sephadex-gel filtration was used to measure orthophosphate in samples from the Bow and Oldman Rivers in March and July of 1980. A column height of 70 cm, inside diameter of 1.6 cm, bed height of 55 cm and temperature of 25°C were used. Both Sephadex G-25 and eluent (0.2% NaCl, 0.03% NaN_3) were degassed prior to use and the flow rate was maintained between 1.7 and 1.8 mL per minute. Effluent from the column was continuously sampled by Technicon proportioning pump sampling at 1.2 mL/min.

2.5 Nutrient Limitation

The nitrogen to phosphorus ratio, absolute concentrations, and algal growth potential studies with and without nitrogen additions were used to evaluate nutrient limitations.

The changing ratio of nitrogen to phosphorus has been used to indicate which nutrient was more limiting in a system (Schindler, 1976; Cross, 1978). That is, if the ratio increased through the system, then the biota were more limited by phosphorus. Other authors have used the absolute nitrogen to phosphorus ratio to determine nutrient limitation to algal growth. Dillon and Rigler (1974) suggested a ratio of 12 from work by Sakamoto (1966), while Grimm, Fisher and Minckley (1981) used 15 and Chacko et al. (1981) used 10 from work by Chiaudani and Vighi (1974).

Algal assays were performed with and without addition of nitrogen to the growth medium. When addition of nitrogen increased the growth potential, nitrogen was then assessed as limiting growth. When addition of nitrogen did not increase the growth potential, then another nutrient was in short supply. The other nutrient was often phosphorus.

2.6 Sediments

Bottom sediments in the river system represent a potential storage component for phosphorus (Reddy, 1978). In order to determine the magnitude of this potential under present conditions, sediment quantity as well as chemically and biologically determined phosphorus forms found in the sediment were measured.

Sediment samples were taken with an airlift sampler which used air pulsation to suspend the fine particulate sediment lodged among the larger gravel and cobble substrate. The sediment and water slurry were collected into a nalgene bucket. Composite sampling at each site, from the areas of the river channel with active flow up to a maximum depth of 1 metre, was carried out from April 1980 to September 1981. The Bow, Oldman and South Saskatchewan Rivers were sampled at five sites, three sites and one site, respectively.

After collection the slurry was filtered through an 80 μ filter and allowed to settle for 20 to 24 hours. The supernatant was then removed and the process repeated to obtain a concentrated slurry suitable for freeze-drying.

Phosphorus fractionation for apatite inorganic, organic and non-apatite inorganic forms was carried out according to the technique of Williams et al., (1976, 1980). Biologically-available phosphorus was determined by static Selenastrum capricornutum bioassays (Miller et al., 1978; Hamilton et al., 1981).

Five replicate quantitative estimates of fine particulate sediment were made in September 1981 at representative river sites. The fine sediments within a 0.1 m^2 closed cylinder, forced into the substrate, were subsampled for non-filterable residue analysis and the total volume of water in the cylinder overlying the substrate was calculated. These values were used to calculate fine particulate sediment per substrate area. No attempt was made to investigate the seasonality of sediment quantity.

To calculate total sediment phosphorus in the Bow River from Calgary to its confluence with the Oldman River and in the Oldman River from Lethbridge to its confluence with the Bow River, the arithmetic average of sediment data, from all sites within the reach, was multiplied by total river substrate area (from data supplied by Stanley Associates Ltd., 1982).

2.7 Loading

Discharge measurements and phosphorus concentration data were used to calculate phosphorus loading at routine sampling sites. Total loading was calculated as the average of the following two formulae:

$$L_1 = \frac{\Sigma c_i q_i}{\Sigma q_i} \, . \, kQ \qquad L_2 = \frac{\Sigma c_i q_i}{n} \, . \, k$$

where L = loading in tonnes
c_i = instantaneous concentration in mg/L,
q_i = mean daily discharge in cms
n = number of observations of both variables
Q = mean discharge in cms
k = constant for unit adjustment.

The two formulae were averaged, since each is an acceptable calculation for use with both instantaneous and daily data but results, because of altering discharge information, can vary.

In the third year of data collection, phosphorus concentration data were collected less frequently at Sites 9 to 12 on the South Saskatchewan River than at other sites. Interpolated data, from the alternate site sampling strategy, were used in calculations of loading to provide more comparable information.

The calculation of net loading within each river reach had to include the effect of external loadings from tributaries, irrigation removal and return flows, sewage treatment plant effluents and other urban and industrial sources. Then, for comparison of different river reaches, loading from an upstream site plus external loadings was subtracted from loadings at a downstream site. This change in loading was expressed per unit of river length (Table 3; Kellerhals, Neill and Bray, 1972).

Tributary and irrigation loadings were calculated from discharge data from Water Survey of Canada stations (Table 3) and concentration data collected between 1977 and 1981. Irrigation return flow data were available at 27 sites from July to October 1977 for total phosphorus, and from May to October 1978 for both total and dissolved phosphorus. Eight return flows were sampled for total and dissolved phosphorus from June to September 1980 and 15 Bow River return flows plus the three withdrawal canals were sampled for total and dissolved phosphorus once in two weeks from June to October 1981. Some tributary data (Elbow, Nose, Fish and Highwood) were available from 1978. Elbow River was sampled for dissolved reactive phosphorus from May to December 1979. Nose Creek was sampled for total and dissolved phosphorus from April to September 1980, and Highwood River was sampled for dissolved and dissolved reactive phosphorus from May to November 1981.

Loadings were calculated for each season from spring 1979 to fall 1981 using average discharge for each season in cms and average phosphorus concentration in mg/L. Average seasonal concentrations from each year were used when available, otherwise concentrations from other years or estimates from available data were used.

Loadings from sewage treatment plants were calculated from data collected by each city. Data from Calgary and Lethbridge were quite complete; Medicine Hat sewage plant loadings were estimated from Lethbridge values before spring 1981. Loadings of dissolved phosphorus were estimated from total phosphorus loadings, using ratios of dissolved to total phosphorus measured in Calgary/Bonnybrook effluent during the diurnal variability study. Urban stormwater and industrial total phosphorus loadings for 1980 are from Hamilton (unpublished) and other values are based on these figures. Industrial dissolved phosphorus loadings were estimated to be equal to total phosphorus loadings, since no data were available. Stormwater dissolved phosphorus loadings were based on the ratio of dissolved to total phosphorus from a 1981 stormwater retention pond study in Calgary and values were applied to stormwater runoff estimates from Medicine Hat. These estimates plus population ratios were used to calculate Lethbridge loadings.

In order to compare the impact of phosphorus loading from the three cities in different years, mean dilution concentration values were calculated. Calgary population figures and sewage treatment plant effluent data were obtained from City of Calgary reports. Annual loading rate of total phosphorus from the City of Calgary sewage treatment plants was divided by mean, June to September discharge of the Bow River at Calgary to calculate a mean dilution concentration. Similar calculations were made with Lethbridge and

Medicine Hat data. However, estimates of phosphorus loadings were used for years 1971 to 1979. These estimates were derived from population estimates and relative Calgary sewage treatment plant loadings.

2.8 Bonnybrook

The Bonnybrook study provided a closer investigation of the one reach of the Bow River most strongly affected by nutrient inputs. Thirteen sampling sites were established from above the Bonnybrook sewage treatment plant to below Site 5 at Carseland (Figure 2). With Site M1 at 0 km, their downstream distance is given in Table 5. Site M8 is at approximately the same location as Site 2 in the Basin study. Water samples were collected every two weeks from May 4 to November 13, 1981 near the left and the right banks. Results from each site were designated R for right bank and L for left bank. Samples were collected from Sites M1 to M12 on the same day, and Site M13 was generally sampled on the previous or subsequent day. Samples were filtered within 16 hours of collection and analyzed using standard procedures for conductivity, pH, chloride, silica, dissolved phosphorus, dissolved reactive phosphorus and nitrate/nitrite (Table 1).

Pearson's correlations were used to determine the relationship between variables. Paired t-tests were used to compare left and right bank data at each site. Loading calculations during the summer period were made at Sites M1, M5, M9 and M13 using average left and right bank concentrations and discharge calculated from Water Survey of Canada data.

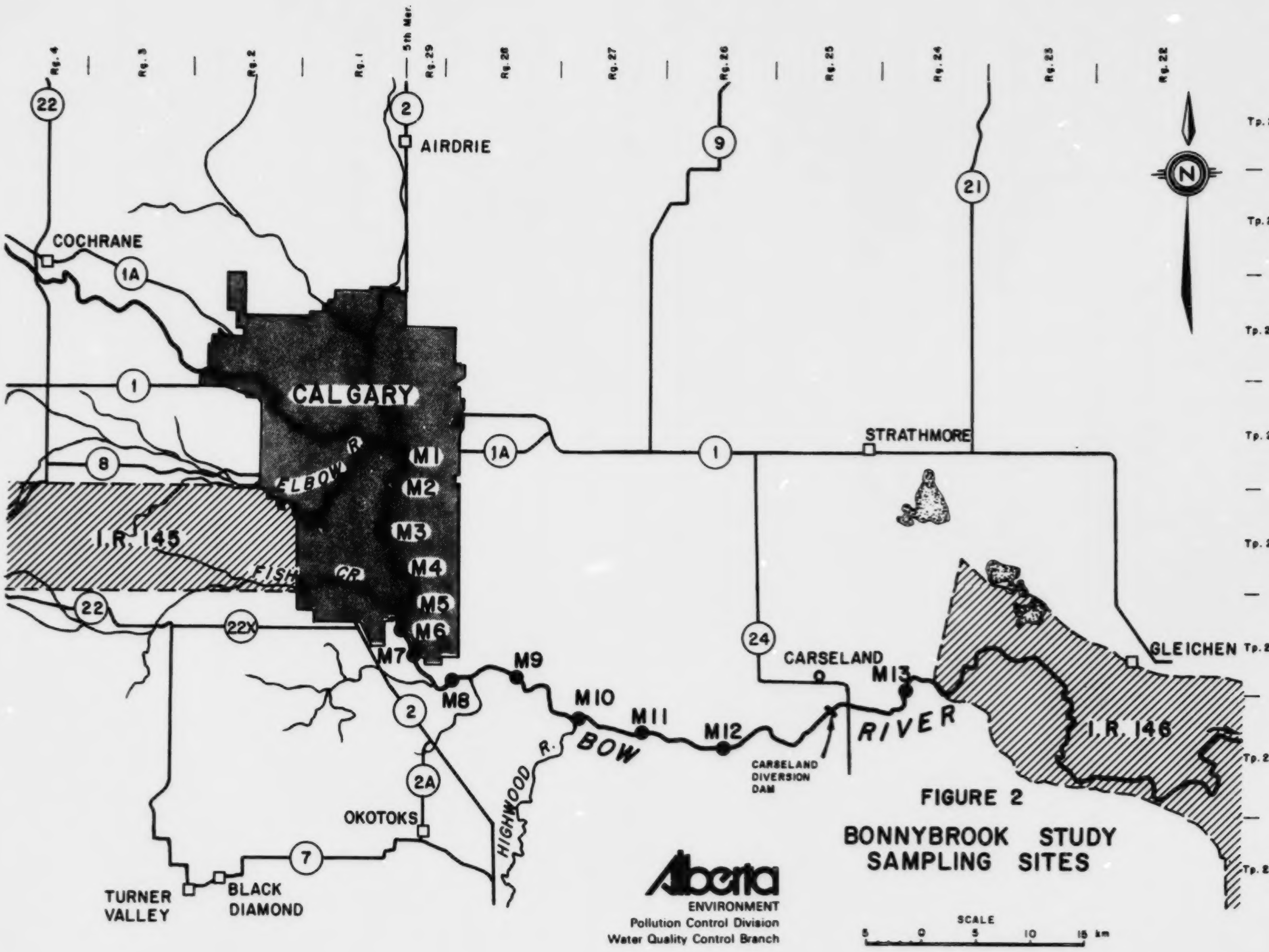
Rg. 4
Rg. 3
Rg. 2
Rg. 1
5th Mer.
Rg. 29
Rg. 28
Rg. 27
Rg. 26
Rg. 25
Rg. 24
Rg. 23
Rg. 22
Tp. 27
Tp. 26
Tp. 25
Tp. 24
Tp. 23
Tp. 22
Tp. 21
Tp. 20
N
22
2
AIRDRIE
9
21
COCHRANE
1A
1
CALGARY
STRATHMORE
1A
1
8
ELBOW R.
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
M11
M12
M13
I.R. 145
FISH CR.
22
22X
24
CARSELAND
GLEICHEN
2
2A
HIGHWOOD R.
BOW
RIVER
CARSELAND DIVERSION DAM
I.R. 146
OKOTOKS
7
TURNER VALLEY
BLACK DIAMOND
SCALE
5
0
5
10
15 km

FIGURE 2
BONNYBROOK STUDY
SAMPLING SITES

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TABLE 5 SITE NUMBER AND LOCATION OF SAMPLING SITES ON BOW RIVER FOR THE BONNYBROOK STUDY

Site Number	NAQUADAT Code	km	Location
M1	BH2200	0	near Inglewood Golf Course
M2	BH2210	2	below Bonnybrook STP Outfall
M3	BH2220	4	near Acadia (Trailer Park)
M4	BH2230	8	near Queensland Downs
M5	BH2240	12	near Deer Run
M6	BM2159	14.5	below Fish Creek
M7	BM2165	17.5	near Academy
M8	BM2160	23	at Stiers Ranch
M9	BM2170	30	near Tree Nursery
M10	BM2175	37	below Highwood River
M11	BM2180	45	near Dalemead
M12	BM2185	52	above Carseland Weir
M13	BM2224	74	near Stangmuir

3.0 RESULTS

3.1 Dissolved Oxygen

Dissolved oxygen (DO) results were erratic occasionally, because of problems with the dissolved oxygen probe or instrument calibration. The effect of calibration can be seen in the results collected at Stiers Ranch in February 1981 (Figure 3). Dissolved oxygen concentrations apparently dropped about 2.3 mg/L between measurements. This change was likely caused by manual resetting of the monitor equipment after dissolved oxygen calibration on site. Other difficulties arising from telemetry and equipment failure sometimes resulted in months with no data or an average monthly value calculated from relatively few data. However, the trends were apparent.

Dissolved oxygen trends on an annual basis were opposite to temperature trends (higher concentrations measured at low temperature) because of the dependence of oxygen solubility on temperature (Figure 4). In addition, dissolved oxygen showed variation over a 24 hour period (Figure 3). This diurnal variation was different between seasons and years at each site.

The largest diurnal change in oxygen concentration occurred on the Bow River below Calgary (Stiers Ranch). In August 1980 the oxygen concentration varied by as much as 7 mg/L during one day, but diurnal fluctuations were also evident to some degree for most seasons. The variation in size of diurnal fluctuation between different years is shown for February, April and August (Figure 3). Diurnal variation seemed to be more consistently low in June and moderate in November.

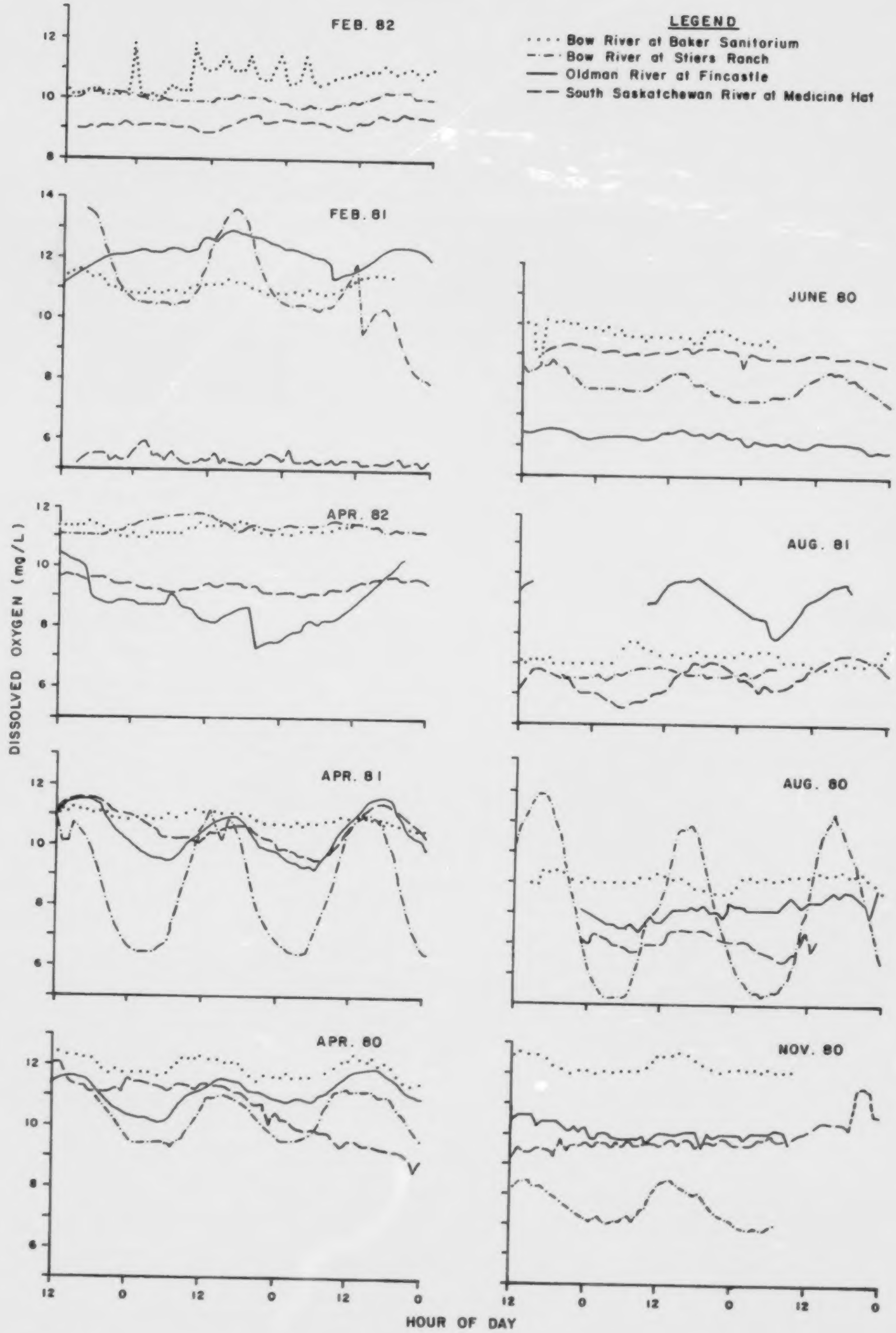

Fig. 3: Comparison of diurnal variability of dissolved oxygen between months and years at remote monitoring sites within the study basin.

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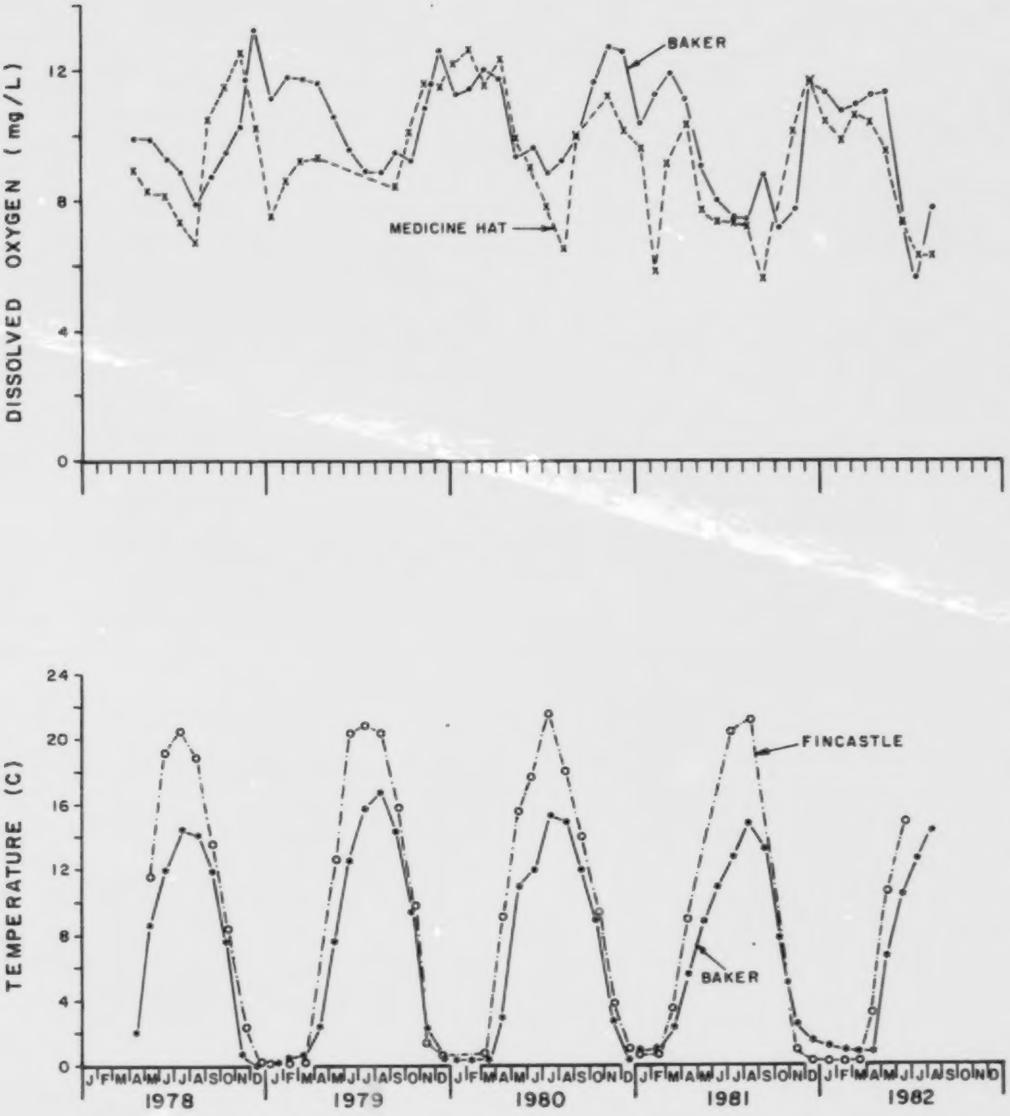

Fig. 4: Monthly average temperature and dissolved oxygen at selected remote monitoring sites within the study basin from 1978 to 1982.

In 1980, diurnal variation at Stiers Ranch was moderate in April and well developed in August, and in 1981 it was large in February and April, but small in August. This variation is affected by climate, flow and plant standing crop. Further studies were made in a technical study and results are reported in Appendix A.

Dissolved oxygen at Baker (on the Bow River above Calgary) was relatively high in all seasons and showed little diurnal variation. Results from Fincastle (on the Oldman River upstream of Site 8) and Medicine Hat (Site 10) showed moderate diurnal fluctuations in April and August, but were relatively constant in the other months.

3.2 Water Temperature

Water temperatures were generally highest in the South Saskatchewan River throughout the year, and the Oldman River was warmer than the Bow River through the spring and summer (Figure 4). July was generally the month with the highest mean monthly temperature in the Oldman and South Saskatchewan Rivers, while highest mean monthly temperatures in the Bow River occurred in either July or August. Summer mean temperatures were higher in the Bow River in 1979 than in 1978, 1980, 1981 and 1982.

Low winter temperatures were measured at all sites except Medicine Hat, which used recirculated warm water from the power plant to keep the intake pipe from freezing. The duration of low mean monthly temperatures (less than 1°C) varied each winter, but generally extended from December to March. The winter of 80/81 was quite mild and short, while that of 81/82 extended into April in the Bow River.

3.3 pH

Values of pH in the Basin followed, roughly, a pattern of high values in late summer and low values in winter (Figure 5 and Appendix Table B-1). A second peak in pH occurred in about May 1980 and April 1981. These patterns were more pronounced in downstream sites. Over the three-year period, values ranged from 7.1 to 9.0 in the Oldman; 7.3 to 9.4 in the Bow; and 7.5 to 9.4 in the South Saskatchewan. The smallest site range in pH (7.9 to 8.4) was recorded at Site 1, Bow River above Calgary.

3.4 Conductivity

Conductivity in the South Saskatchewan River Basin was consistently highest in winter and lowest in summer (Figure 6 and Appendix Table B-1). Transition from high to low values occurred rapidly in spring at most sites. The return from low to high values was also rapid in fall at most sites. The exceptions were Site 1 (Bow River above Calgary) and Site 3 (Oldman River above Lethbridge), where the increase from low values in June to high values in winter was gradual. However, decrease to low values in spring was rapid at these two sites.

Conductivity was lower in the Bow River than in the Oldman and South Saskatchewan Rivers, with a mean value of 366 µS/cm compared to 418 and 413 µS/cm, respectively. Also, the pattern of conductivity trends at the Bow River sites was much smoother, particularly at upstream sites, than at Oldman River sites. Overall, conductivity was

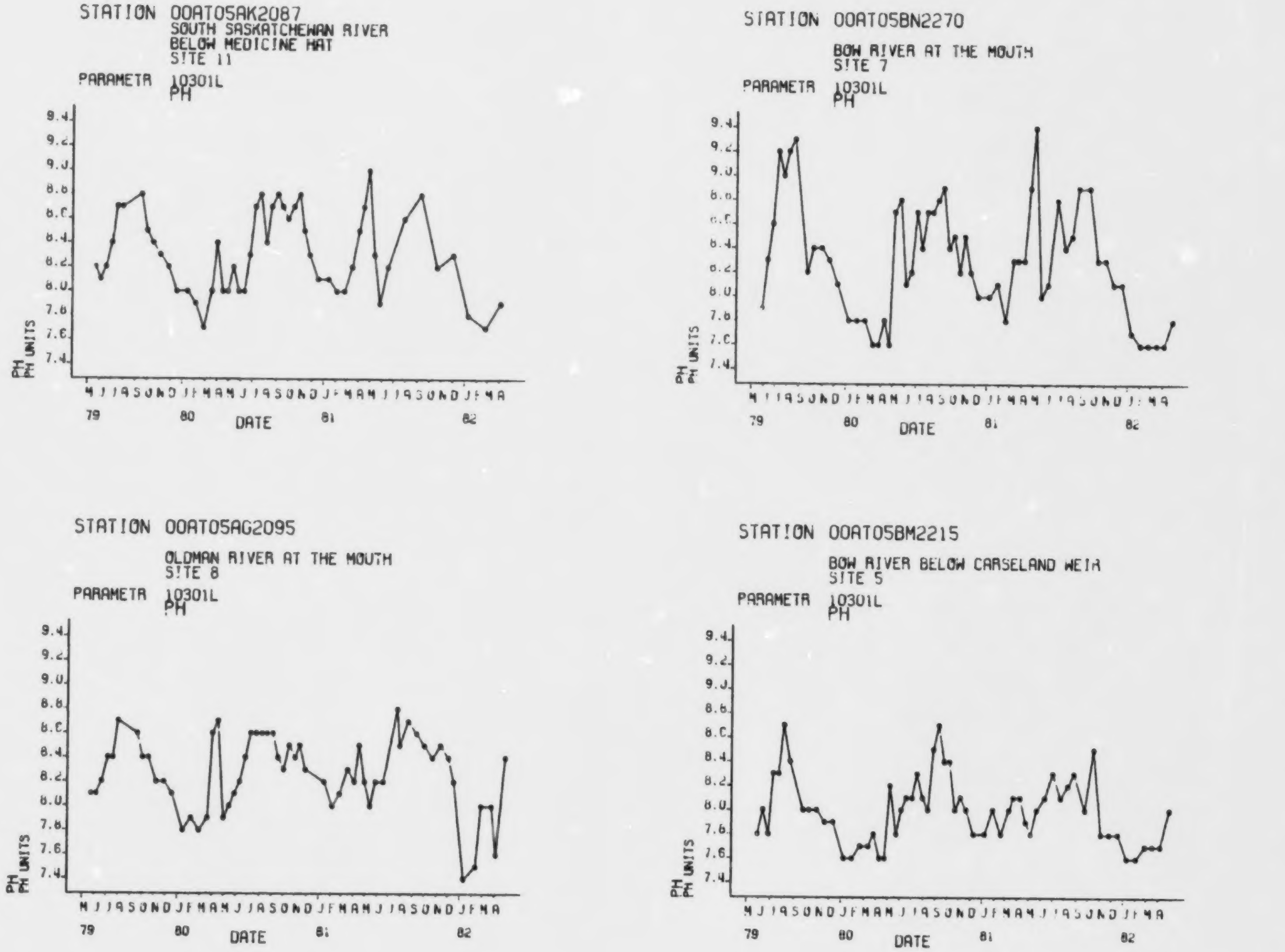

Fig. 5. Comparison of pH data from four sites in the study basin.

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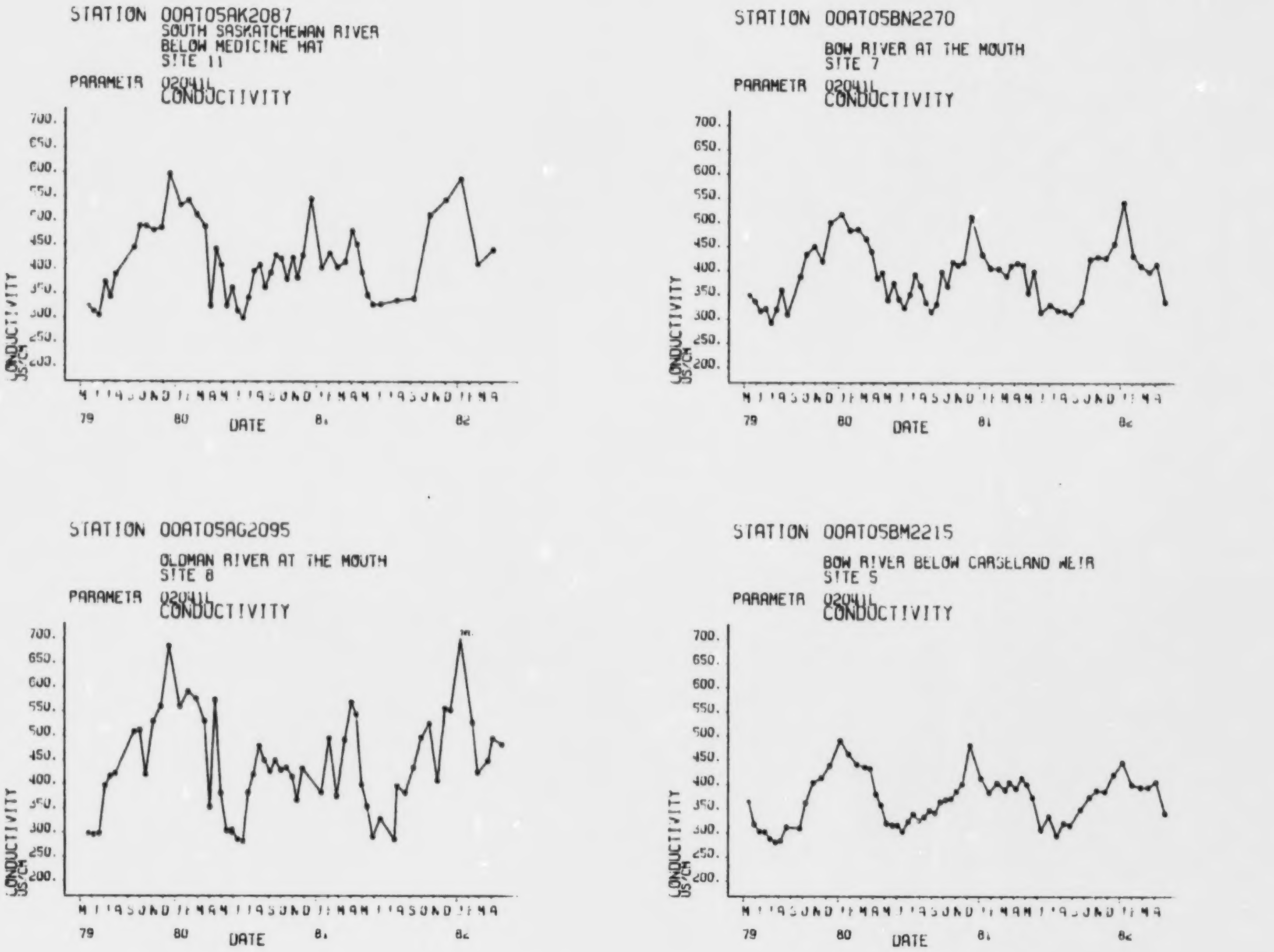

Fig. 6. Comparison of conductivity data from four sites in the study basin.

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correlated with total alkalinity (r = 0.79), dissolved inorganic carbon, (r = 0.70) and chloride (r = 0.64). Correlations of conductivity with dissolved inorganic carbon and chloride were improved for the Oldman and South Saskatchewan Rivers when each river was treated separately (Appendix Table A-7).

Statistical tests (Table 6) comparing data between years, showed that there was no significant difference between 1980 and 1981 values. However, when the seasons were compared separately, the differences between years were significant in most cases. A further test comparing data between seasons showed that the seasons were all significantly different with the exception of spring and summer in the South Saskatchewan River.

3.5 Alkalinity

Total alkalinity had a seasonal pattern of higher winter values and lower summer values (Figure 7 and Appendix Table B-1). The winter peak values were most pronounced in the Oldman, South Saskatchewan and lower Bow River sites. Small spring increases in concentration were also measured during April and May on all three rivers. Alkalinity values were correlated with dissolved inorganic carbon (r = 0.85; Appendix Table A-7).

In the Bow River winter peak values increased at each downstream site from greater than about 130 mg $CaCO_3$/L at Site 1 to greater than 160 mg $CaCO_3$/L at Site 7. The increase to and decrease from the winter peak was gradual at Sites 1, 2, 5 and 6, though at Sites 5 and 6 a sharper winter peak was superimposed on this trend. At Sites

TABLE 6 COMPARISON BETWEEN 1980 AND 1981 DATA USING MANN-WHITNEY U TESTS AND BETWEEN YEARS FOR EACH SEASON USING KRUSKAL-WALLIS ONE-WAY ANQVA TESTS (*p < .05, **p < .01). COMPARISON BETWEEN SEASONS (YEARS COMBINED) USING MANN-WHITNEY U TESTS. SEASONS NOT SIGNIFICANTLY DIFFERENT ARE TABULATED (P-SPRING, S-SUMMER, F-FALL, W-WINTER).

	TP	DP	DN	TURB	POC	COND	CL	S1
ALL DATA								
1980 vs 1981			**	**			*	
Spring	*		*	**		**	**	
Summer		*	*	**		*	**	**
Fall				**		**	**	*
Winter	**	**	**	**	*	**	**	**
Seasons	P-W S-F	none	P-F	S-F	S-F	none	P-S	P-W
BOW RIVER								
1980 vs 1981			*	**			**	
Spring				*		**	**	
Summer	*	**		**		**	**	**
Fall							*	
Winter	**	**	**	*		**	**	**
Seasons	P-F	P,S-F	P-F	S-F,W F-W	S-F,W F-W	none	P-F	none
OLDMAN RIVER								
1980 vs 1981			**	**				
Spring							**	**
Summer								
Fall				**		**	*	
Winter			**	**	**	**	**	
Seasons	S-F	P,S-F	P-F	S-F	S-F,W F-W	none	S-P,F,W F-P,W	P-W S-F
SOUTH SASKATCHEWAN RIVER								
1980 vs 1981							*	
Spring	**		**	**	*	**	**	
Summer		**	*	**		*	**	
Fall	**			**		**	**	**
Winter	**	**	**	**		**	**	
Seasons	S-F	S-F	P-F	S-F	S-F	P-S	P-S F-W	P-W S-F

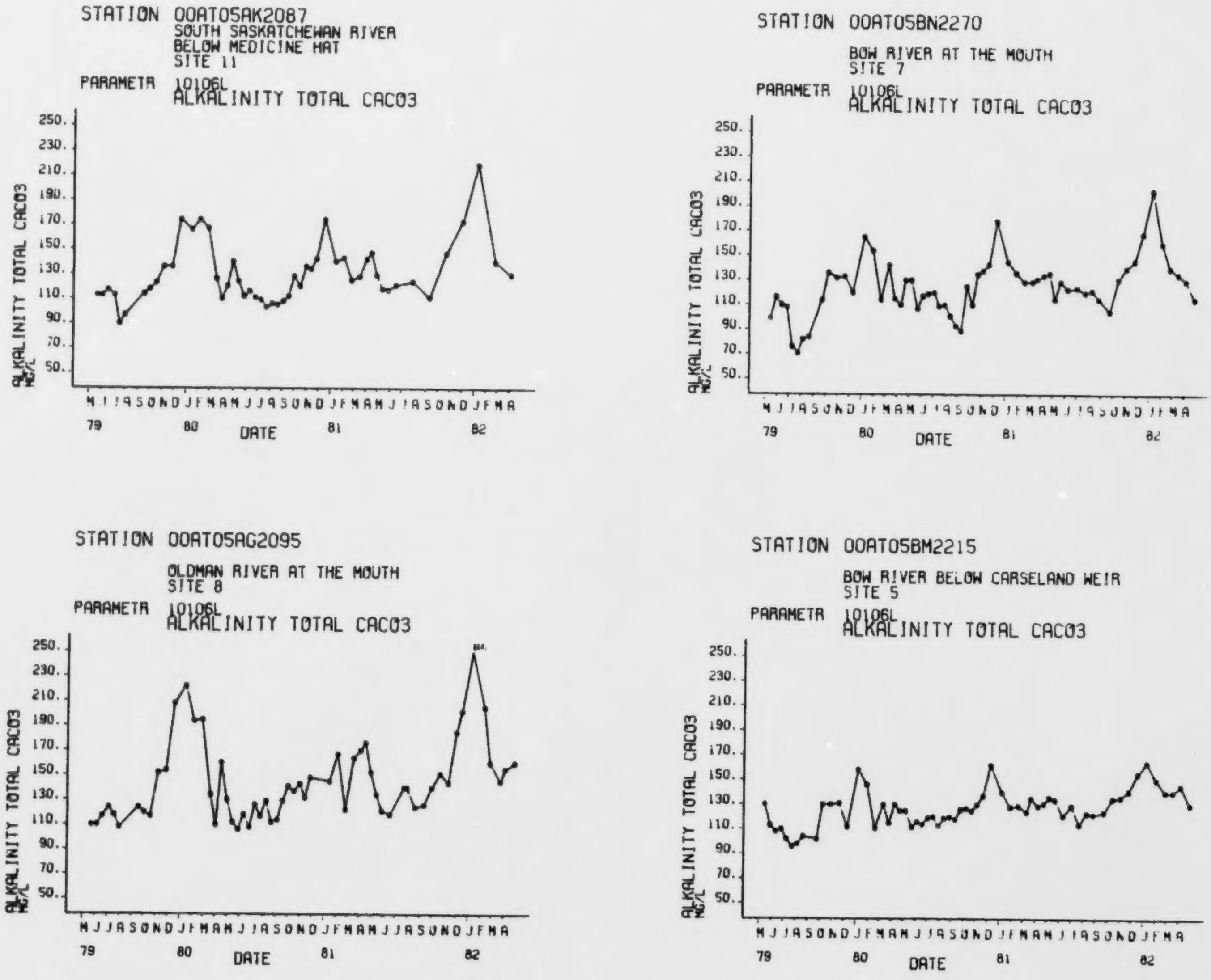

Fig. 7. Comparison of total alkalinity data from four sites in the study basin.

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13 and 7, however, the decrease was gradual from the February high to the August low values (less than 100 mg $CaCO_3$/L). The increase was more rapid to the winter high values at Sites 13 and 7.

In the Oldman River lowest values occurred around May. In 1979 and 1981 these were followed by constant to increasing values until October when concentration increased dramatically. In 1980, however, the concentration increase from May to winter was more gradual and the winter peak was less well-defined.

Alkalinity at the South Saskatchewan River sites showed a combination of Bow and Oldman River trends, with strongly defined winter highs and summer lows, and balanced, rapid-transition phases in spring and fall. Average alkalinity was 127 mg $CaCO_3$/L in the South Saskatchewan River, 141 mg/L in the Oldman River, and 123 mg/L in the Bow River.

Phenolphthalein alkalinity values were highest in summer (averaging 0.6 to 21.2 mg/L) and lowest in winter (averaging 0 to 0.3 mg/L) (Appendix Table B-1). At Sites 1 and 2, in the Bow River, phenolphthalein alkalinity was detectable only in the summer. Further downstream, at Site 7, average summer values were 14.0 mg $CaCO_3$/L, but phenolphthalein alkalinity was also detectable in spring and fall. In the Oldman and South Saskatchewan Rivers, the average summer values at six of the seven sites ranged from 3.3 (Site 3) to 7.0 mg $CaCO_3$/L (Site 4). Values at Site 9 were higher than at the other sites (21.2 mg $CaCO_3$/L).

3.6 Turbidity and Residues

Turbidity and residues, both non-filterable (NFR) and non-filterable fixed (NFFR), are highly correlated (r > 0.95, Appendix Table A-7). Highest turbidity values were measured in May/June of each year with lesser peaks in March/April (Figure 8, 9 and Appendix Table B-1). These two spring peak values were separated more distinctly in the Bow River than in the Oldman River. Within the Bow River, peak values at sites above the Bassano Dam were low, while those below Bassano were higher and more distinct. Smaller increases were also measured in October/November on the Bow River.

Turbidity values in the Oldman River (averaging 56 JTU) were much higher than those in the Bow River (averaging 7 JTU), and those in the South Saskatchewan River were intermediate (averaging 29 JTU). Residue peak values were more distinct in the Oldman than the Bow River, with non-filterable residue values greater than 500 mg/L occurring in May/June of each year (Appendix Table B-1). South Saskatchewan River sites reflected a combination of Bow and Oldman River characteristics with distinct residue peak values but reaching lower peak concentrations.

Statistical·testing of turbidity data (Table 6) showed that values were significantly different in most cases between 1980 and 1981 and between years seasonally. A testing of seasonal differences showed that only differences in spring and fall values were not significant.

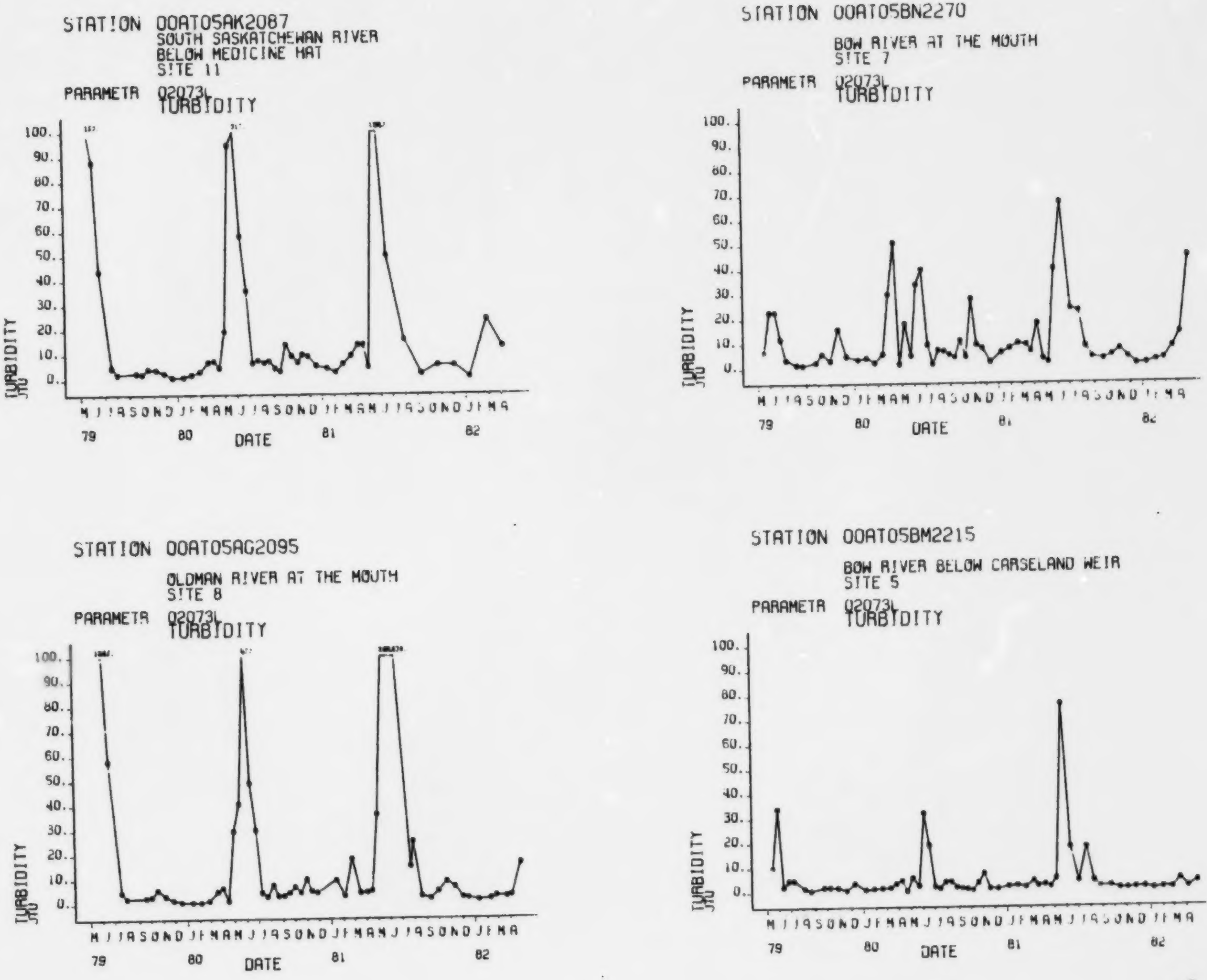

Fig. 8. Comparison of turbidity data from four sites in the study basin.

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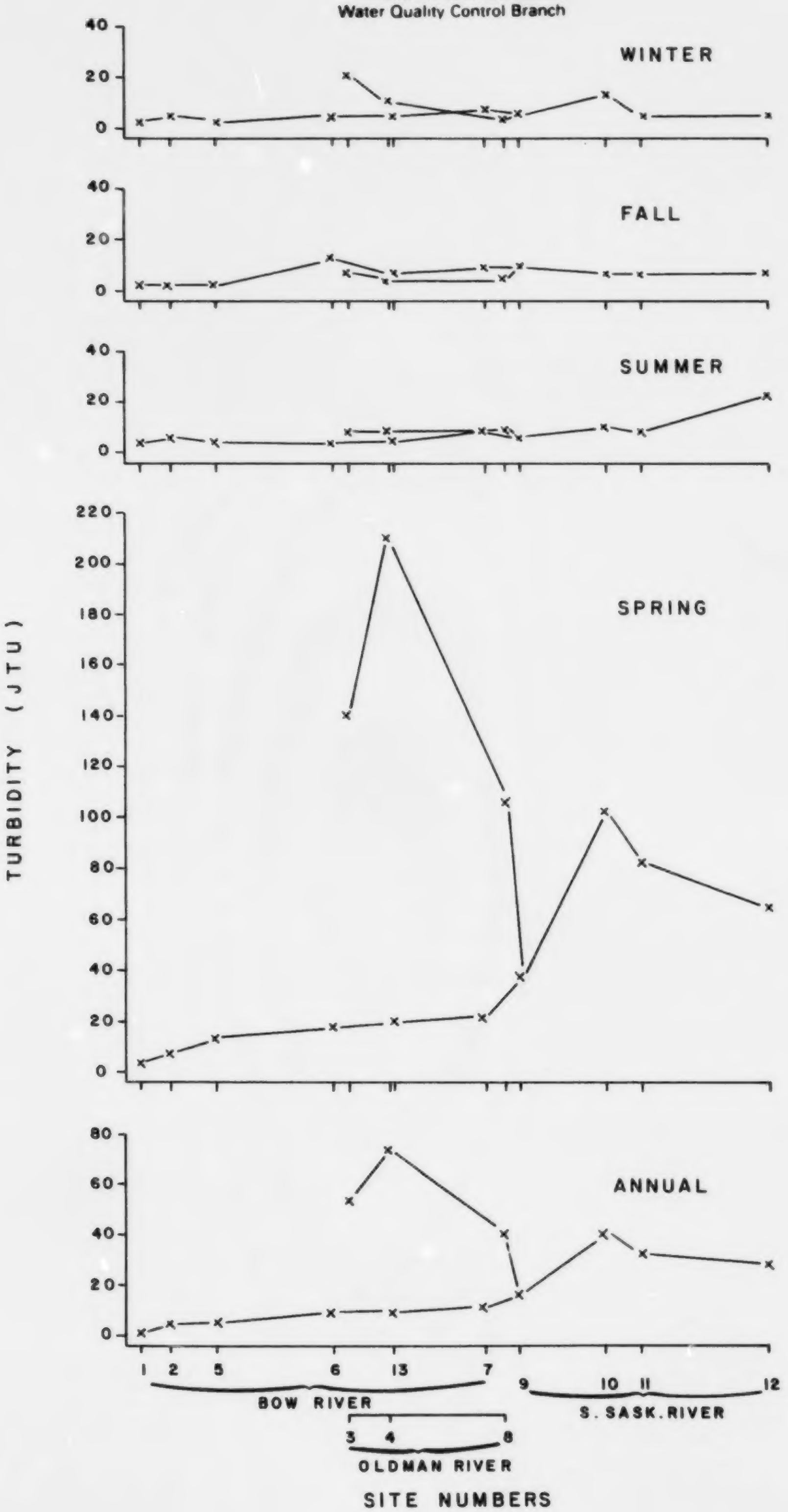

Fig. 9 : Annual and seasonal average values of turbidity at each site in the study basin.

3.7 Chloride

Average chloride (Cl) concentrations in the Bow, Oldman and South Saskatchewan Rivers were 4.4, 3.5 and 5.2 mg/L, respectively. Low concentrations (less than 2 mg/L) were measured in June/July in the Bow and South Saskatchewan, and slightly earlier in the Oldman River (Figure 10 and Appendix Table B-1). Concentrations increased rapidly at first, then more gradually from August to November, to higher winter concentrations. The drop-off to low values in spring was rapid. Generally, chloride concentrations were significantly different between years, both annually and seasonally (Table 6).

3.8 Silica

Collection of silica (Si) data began in January 1980. Peaks in silica concentration occurred twice during the year, in mid-winter and in late spring/early summer, at values of about 4 to 6 mg/L (Figure 11, 12 and Appendix Table B-1). Low values (less than 1 mg/L) were measured in late summer/fall and briefly in early spring. These fluctuations were less pronounced at upstream Bow River sites. Concentrations at Site 1 ranged from 3.0 to 4.8 mg/L and those at Site 2 ranged from 2.0 to 5.5 mg/L.

Silica concentrations were statistically similar between years (Table 6). Seasonally however, results were less consistent, with different seasons in each river showing statistically different results between years. When the seasons were compared, spring and winter results were similar, using the data from all three rivers combined. This was not true for Bow River data alone. In the Oldman and South Saskatchewan Rivers spring and fall were also similar.

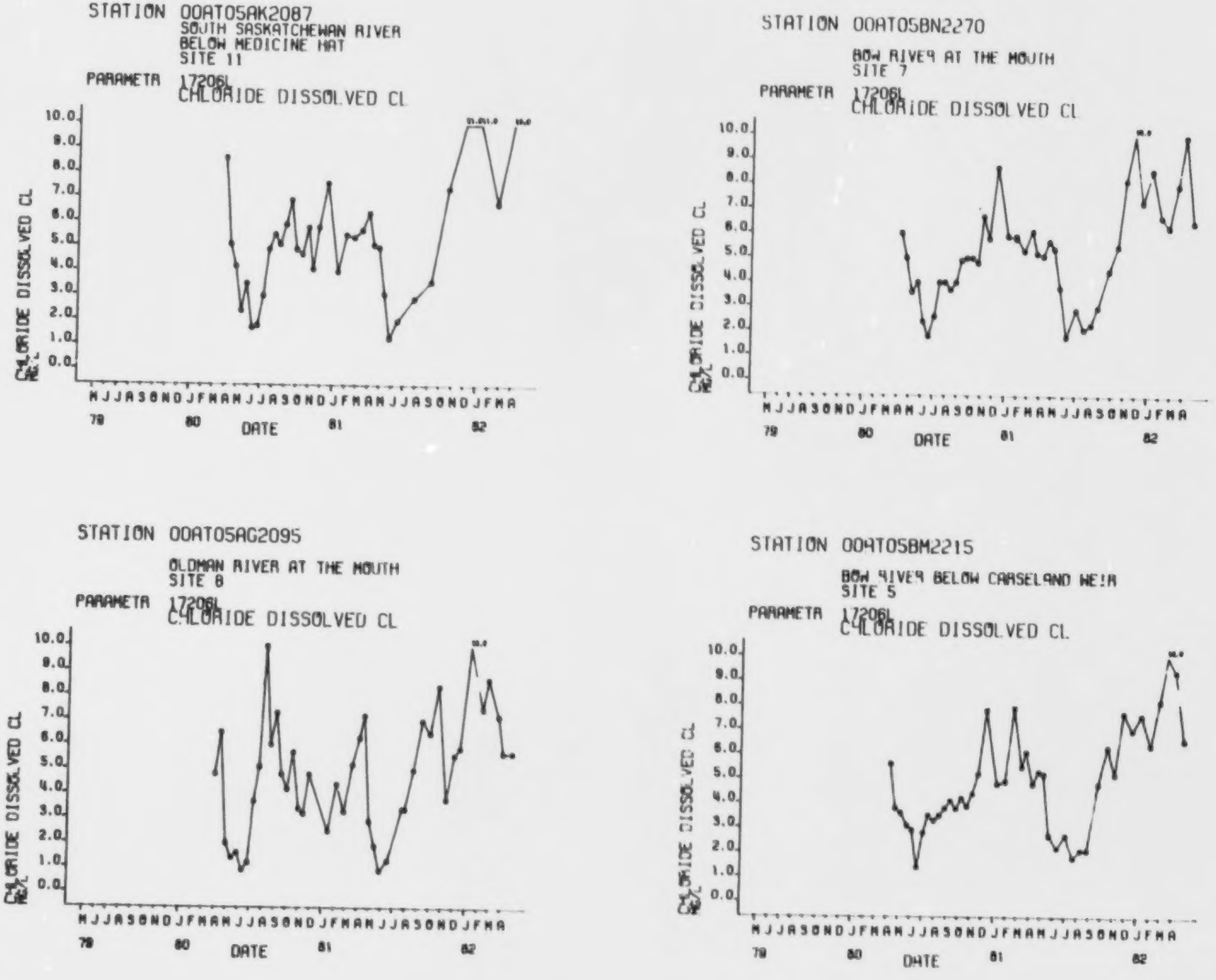

Fig. 10. Comparison of dissolved chloride data from four sites in the study basin

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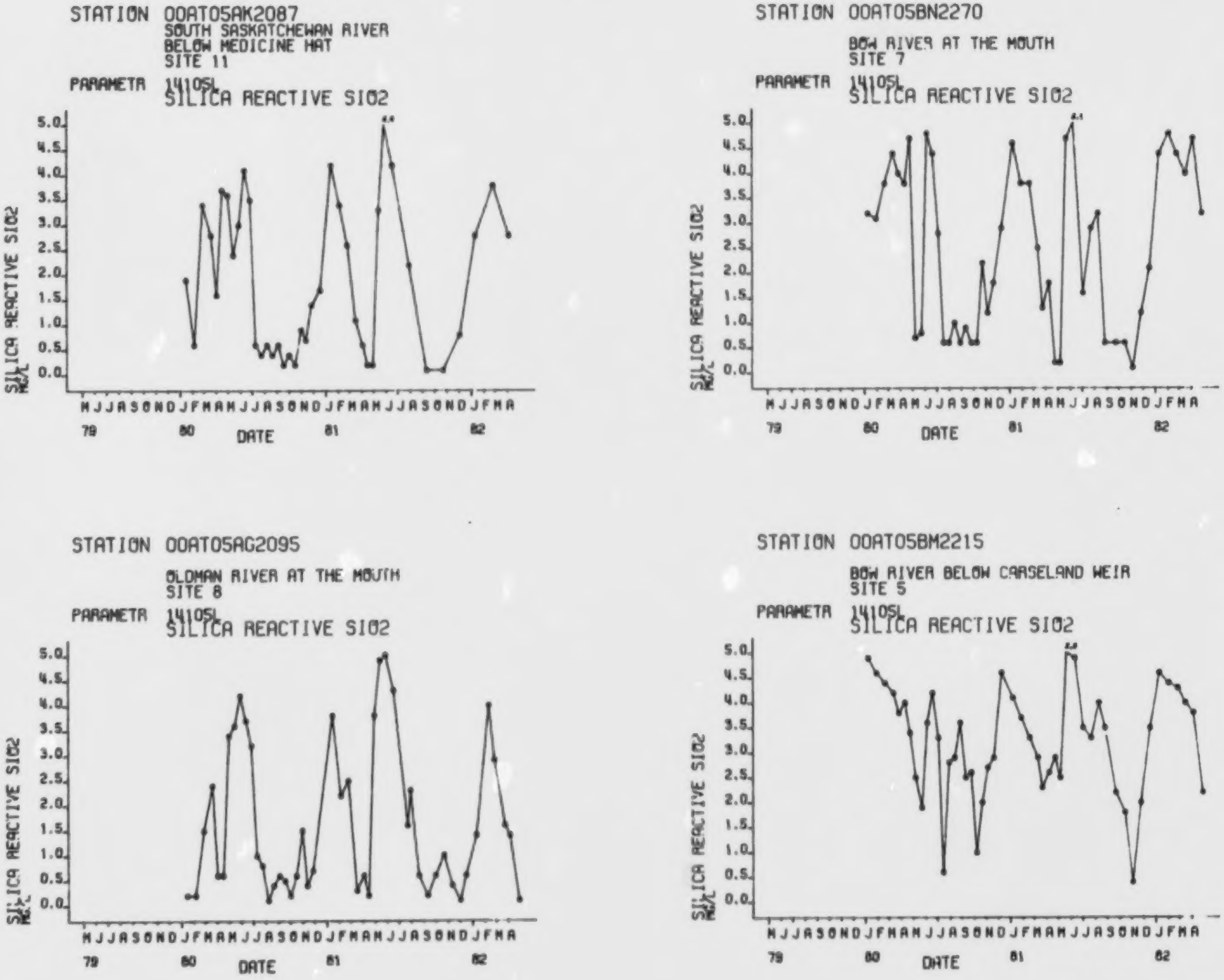

Fig. 11. Comparison of reactive silica data from four sites in the study basin.

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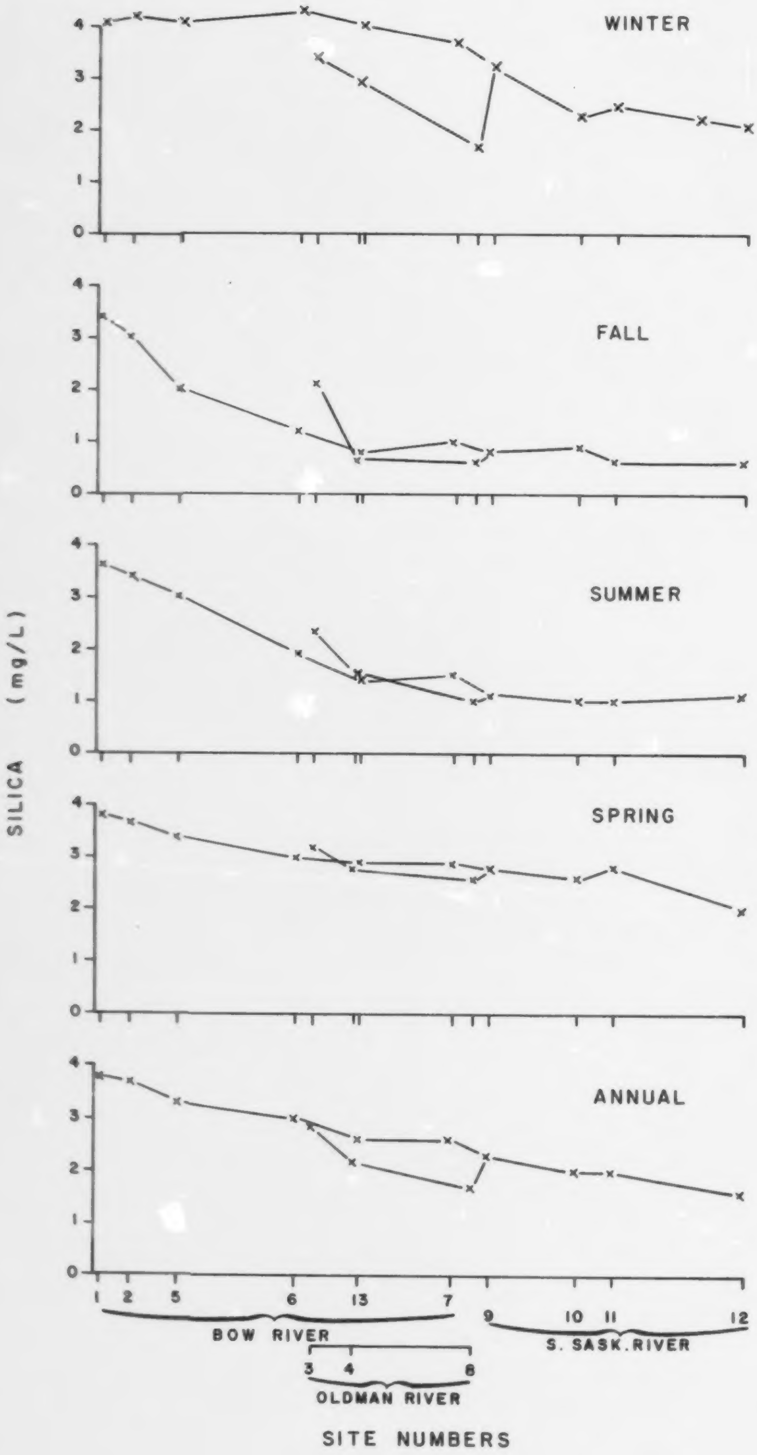

Fig. 12: Annual and seasonal average concentrations of reactive silica at each site in the study basin.

3.9 Carbon

Collection of three carbon forms, particulate organic (POC), dissolved organic (DOC), and dissolved inorganic (DIC) began in January 1980. Average concentrations of particulate organic carbon were higher in the Oldman (1.3 mg/L) and the South Saskatchewan Rivers (1.4 mg/L) than in the Bow River (0.9 mg/L). Particulate organic carbon was correlated with turbidity (r = 0.69) and non-filterable residue (r = 0.72). This correlation was stronger in the Oldman (r = 0.83 and 0.89) than in the South Saskatchewan (r = 0.74 and 0.57) or the Bow Rivers (r = 0.64 and 0.77; Appendix Table A-7). The spring peak values of particulate organic carbon were apparent, however they were less pronounced in the Bow River than the turbidity peaks (Figure 13, 14 and Appendix Table B-1). One notable difference between turbidity peaks and particulate organic carbon patterns occurred at Site 2, Bow River below Calgary, where particulate organic carbon did not have any strong pattern over the sampling period. In fact, the correlation with turbidity was only 0.47, the lowest at any site.

Statistically, particulate organic carbon was not significantly different between years overall and seasonally in most cases (Table 6). Seasonal comparisons showed that spring was most often different from the other seasons.

Throughout the Basin, dissolved organic carbon followed a trend of higher values in April or May, but concentrations at other times of the year varied (Appendix Table B-1). Values at Site 1, Bow above Calgary, were generally lower than downstream sites, but this was not

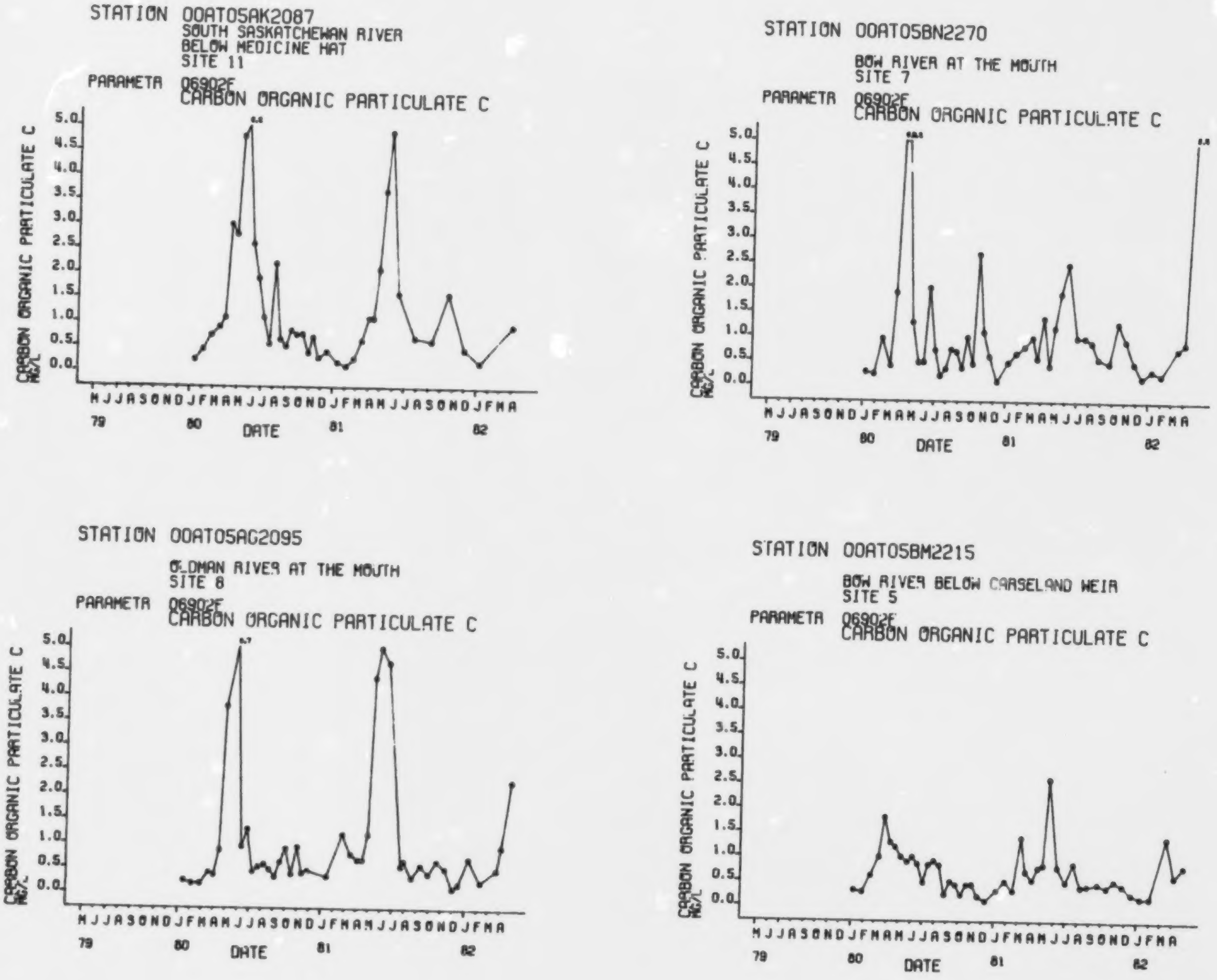

Fig. 13. Comparison of particulate organic carbon data from four sites in the study basin.

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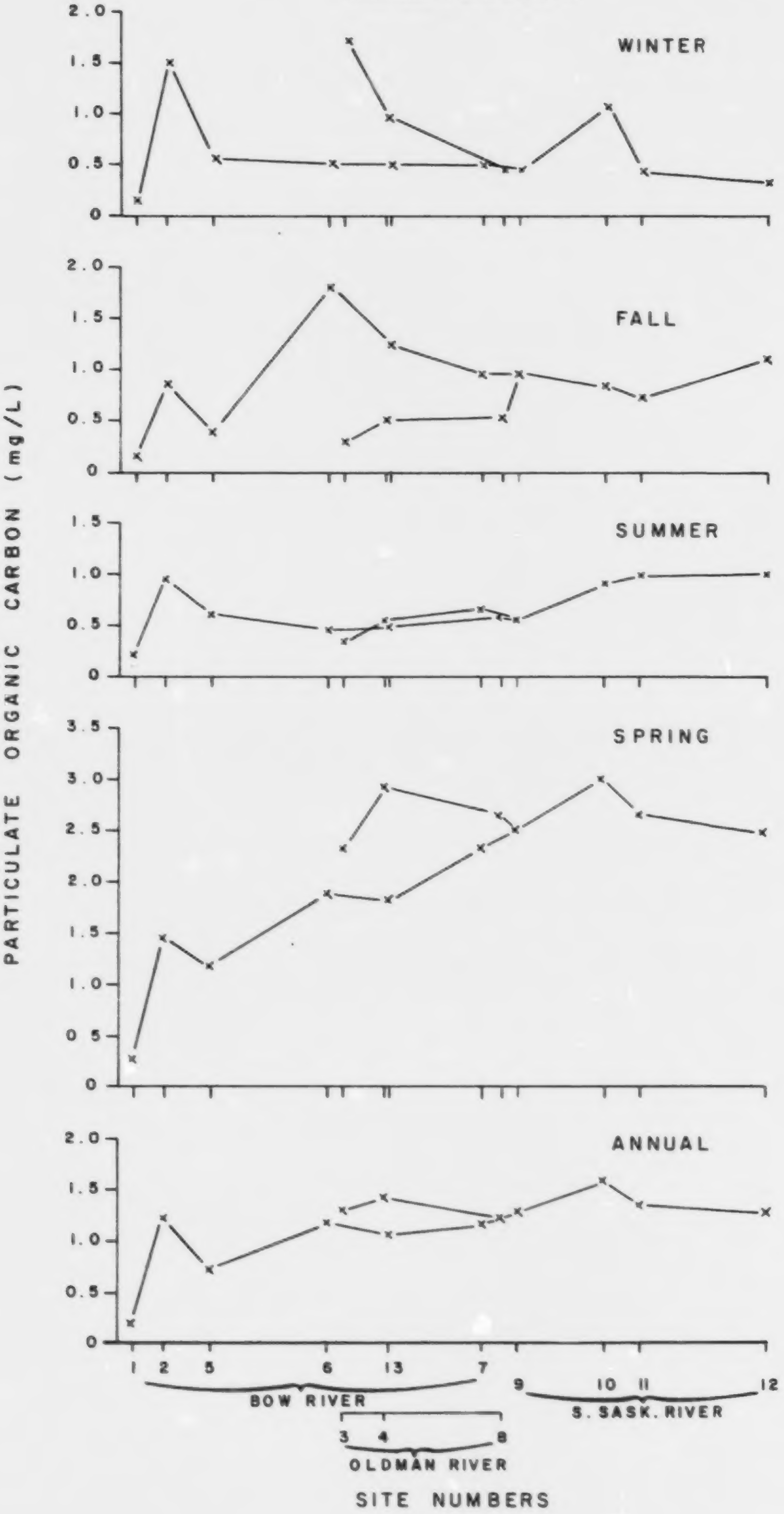

Fig. 14 : Annual and seasonal average concentrations of particulate organic carbon at each site in the study basin.

as obvious at Site 3, Oldman above Lethbridge. Average concentrations of dissolved organic carbon in the Bow, Oldman and South Saskatchewan Rivers were 2, 3 and 3 mg/L, respectively.

Dissolved inorganic carbon concentrations were higher in winter and lower in summer, with variable transition patterns at different sites (Appendix Table B-1). Average concentrations in the Bow, Oldman and South Saskatchewan Rivers were 28.8, 32.5 and 29.2 mg/L, respectively.

3.10 Nitrogen

Nitrogen was collected and analyzed in several forms: nitrate plus nitrite (NIT); dissolved nitrogen (DN); ammonia (NH_3); and particulate nitrogen (PN). Total nitrogen (TN) was the addition of dissolved nitrogen and particulate nitrogen.

3.10.1 Nitrate/Nitrite and Total Nitrogen

Correlation coefficients between dissolved nitrogen (DN) and nitrate plus nitrite (NIT) were high, ranging from 0.87 in the Bow River to 0.94 and 0.96 in the Oldman and South Saskatchewan Rivers, respectively (Appendix Table A-7). Similarly, total nitrogen (TN) was correlated to dissolved nitrogen and nitrate/nitrite (r = 0.71 for total nitrogen vs nitrate/nitrite in the Oldman River to r = 0.97 for total nitrogen vs dissolved nitrogen in the Bow River). Since dissolved nitrogen and nitrate/nitrite were highly correlated only dissolved nitrogen trends will be discussed.

3.10.2 Dissolved Nitrogen

Throughout the Basin, dissolved nitrogen followed a general trend of high winter values and low summer values (Figure 15 and Appendix Table B-1). These seasonal fluctuations were strong in the Bow River, with the exception of Site 1, where dissolved nitrogen fluctuated between 0.05 and 0.32 mg/L. Otherwise, high winter values averaged from 2.16 to 1.84 mg/L and low summer values averaged from 1.12 to 0.28 mg/L (Figure 16). The winter values in 1981 were distinctly lower than winter values in 1980 and 1982.

In each season the highest concentrations of dissolved nitrogen were measured at Site 2 and values decreased at each downstream site to Site 7. A second trend was evident at these sites below Calgary. At Site 2 the low summer concentration was measured in July and began to increase immediately, but at each successive downstream site, the dissolved nitrogen concentrations stayed longer at the lower values. In fact, by Site 7, the low values were measured from July to the end of September.

Dissolved nitrogen values in the Oldman River were generally lower than those in the Bow River below Calgary. Concentrations were less than 0.5 mg/L, in general, and the increase in concentration below Lethbridge was much less substantial than below Calgary. Higher values (averaging 0.69 mg/L) were measured over winter at each site, though these were not pronounced at Site 3 or in 1981 and were much lower than winter values in the Bow River.

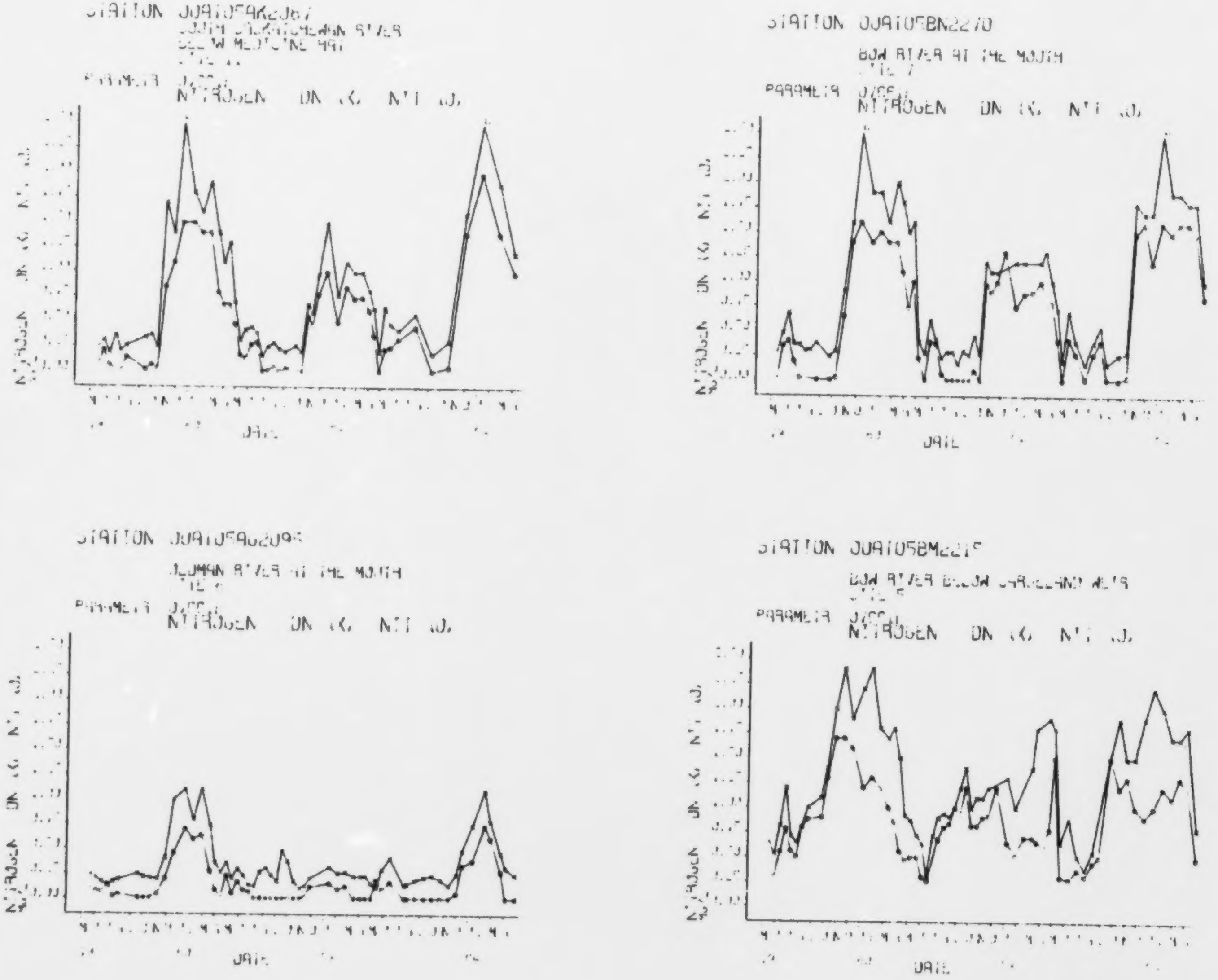

Fig. 15. Comparison of dissolved nitrogen and nitrate + nitrite data from four sites in the study basin.

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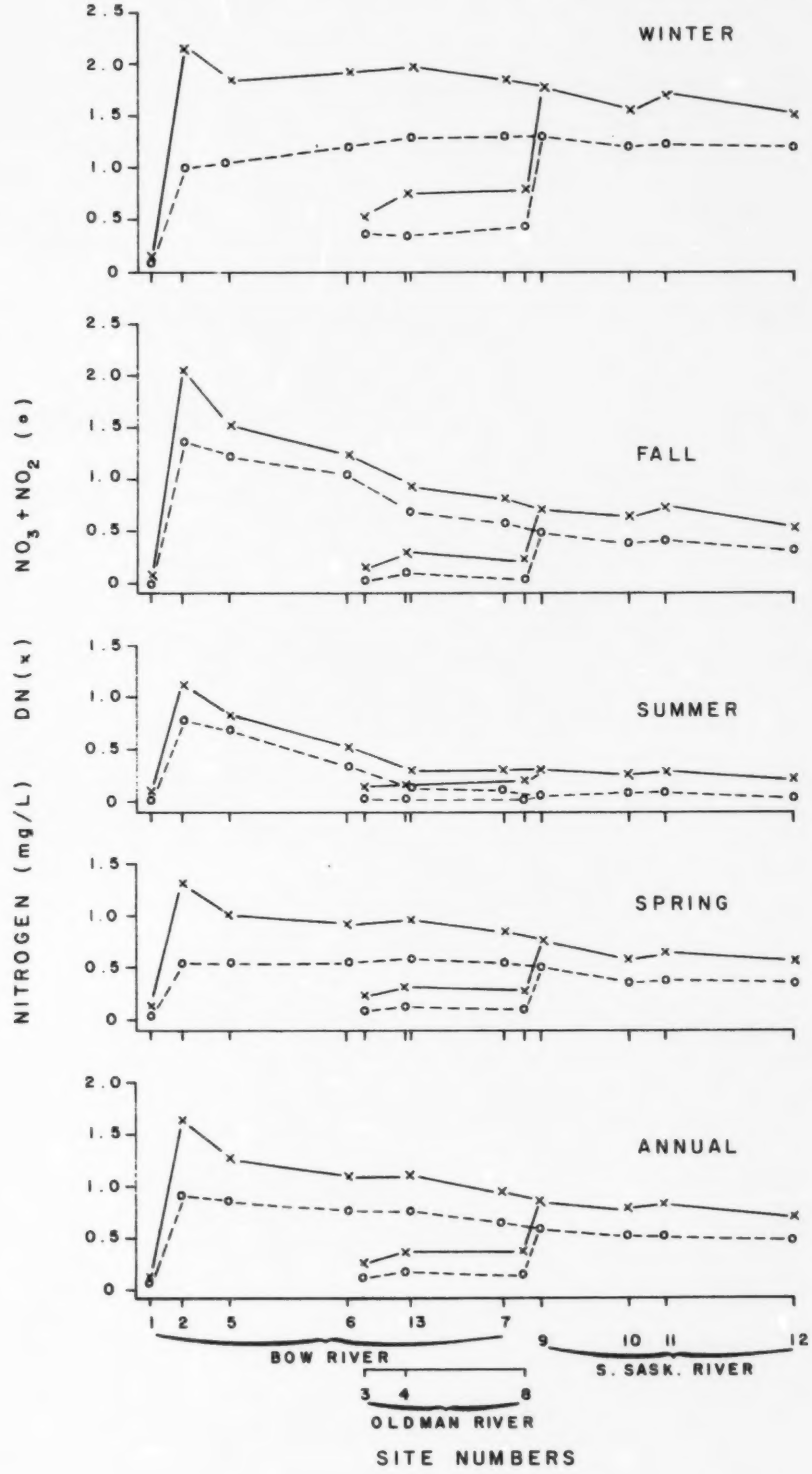

Fig. 16: Annual and seasonal average concentrations of dissolved nitrogen and nitrate + nitrite at each site in the study basin.

The South Saskatchewan River concentrations of dissolved nitrogen showed a seasonal pattern very similar to that in the lower Bow River sites. Longitudinally, there was very little change with only a slight reduction in concentration at each downstream site, except for a small increase below Medicine Hat.

Statistical tests of dissolved nitrogen data (Table 6) showed that with data from all the rivers combined, there was a difference between 1980 and 1981 values. When the rivers were treated separately, however, comparisons between years and for each season were less consistent. Bow and Oldman River values were different between years and in winter; South Saskatchewan River values were not different between years, but were different in all seasons except fall. Comparisons between seasons showed consistently that spring and fall values were similar.

3.10.3 Ammonia

Ammonia concentrations at Site 1 and Site 3, upstream of Calgary and Lethbridge, were below detection (< 0.1 mg/L) during the study except for three measurements. Highest ammonia concentrations were at Site 2, Bow River below Calgary, during winter and early spring (maximum of 2.9 mg/L). The size and duration of these high values decreased at successive downstream sites in the Bow River (Figure 17 and Appendix Table B-1) so that concentrations were mostly below detection for summer and fall. The peak in winter 1982 was much lower at Site 2 than in previous winters, though this was not true at downstream sites.

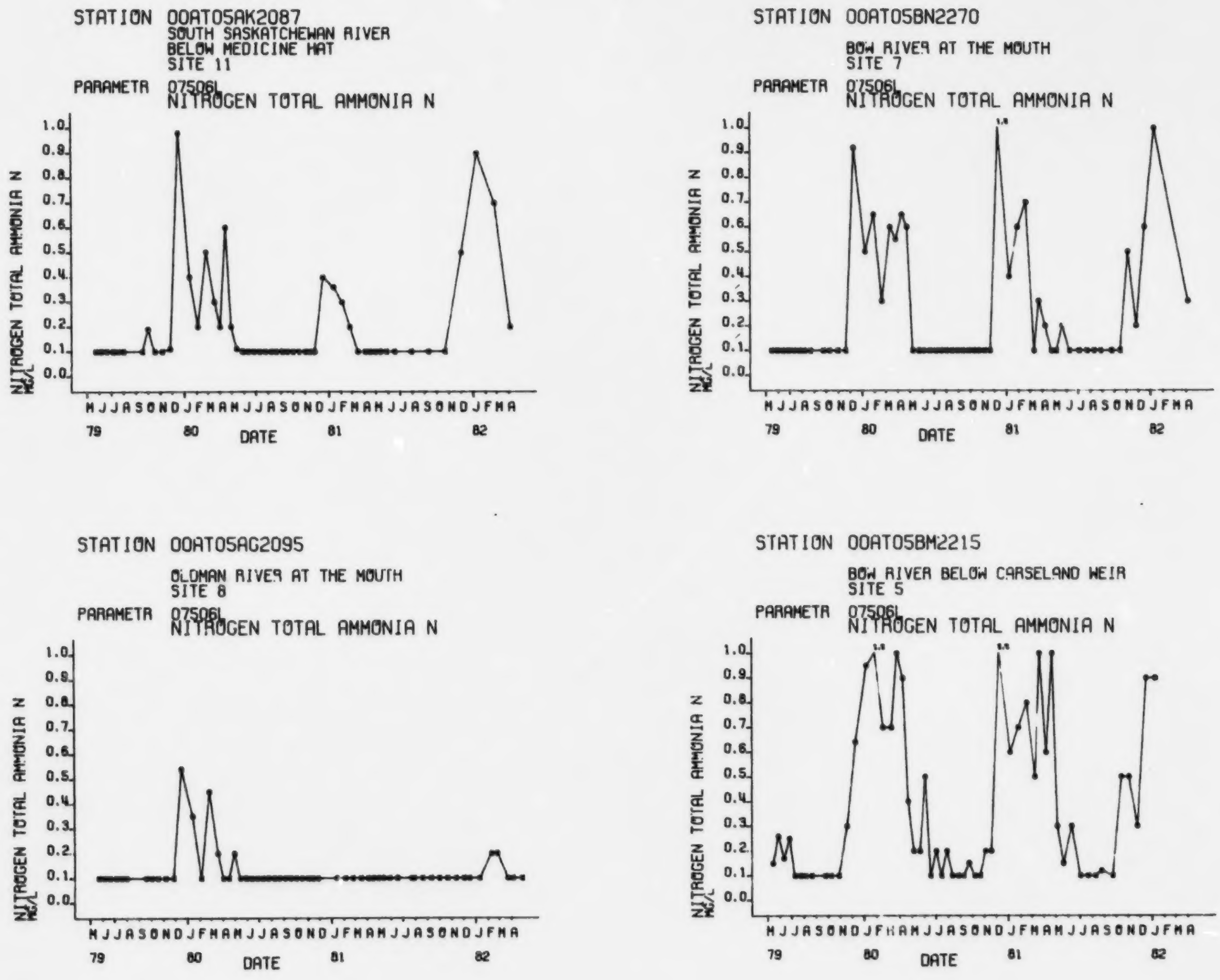

Fig. 17. Comparison of total ammonia nitrogen data from four sites in the study basin.

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The trend of decreasing winter peaks of ammonia was continued through the South Saskatchewan River sites except at Site 11, below Medicine Hat, where peaks were slightly higher. In the Oldman River below Lethbridge at Sites 4 and 8, ammonia concentrations were at detection level except in winter and early spring. Peak values of 0.8 mg/L were measured except in winter 1981, when no peak developed.

3.10.4 Particulate Nitrogen

Particulate nitrogen concentrations in the Bow River (Figure 18 and Appendix Table B-1) fluctuated with several single high value peaks (greater than 0.3 mg/L). These were inconsistent among sites, but tended to occur in spring and fall. Concentrations at Site 2 were generally higher throughout the study period (averaging 0.22 mg/L) than at the other Bow River sites (averaging 0.05 to 0.19 mg/L).

Peaks in particulate nitrogen were more consistent in the Oldman River, and recurred in May/June of each year at all sites. Additional high values were measured in winter 1981 and fall 1979. In the South Saskatchewan River, particulate nitrogen peaks in spring/early summer were well-defined, as was a peak in fall 1981. Average concentrations in both rivers ranged from 0.18 to 0.27 mg/L.

3.11 Phosphorus

The five forms of phosphorus measured in the river - total (TP), total inorganic (TIP), dissolved (DP), dissolved inorganic (DIP) and dissolved reactive (DP) followed similar trends in many cases. This

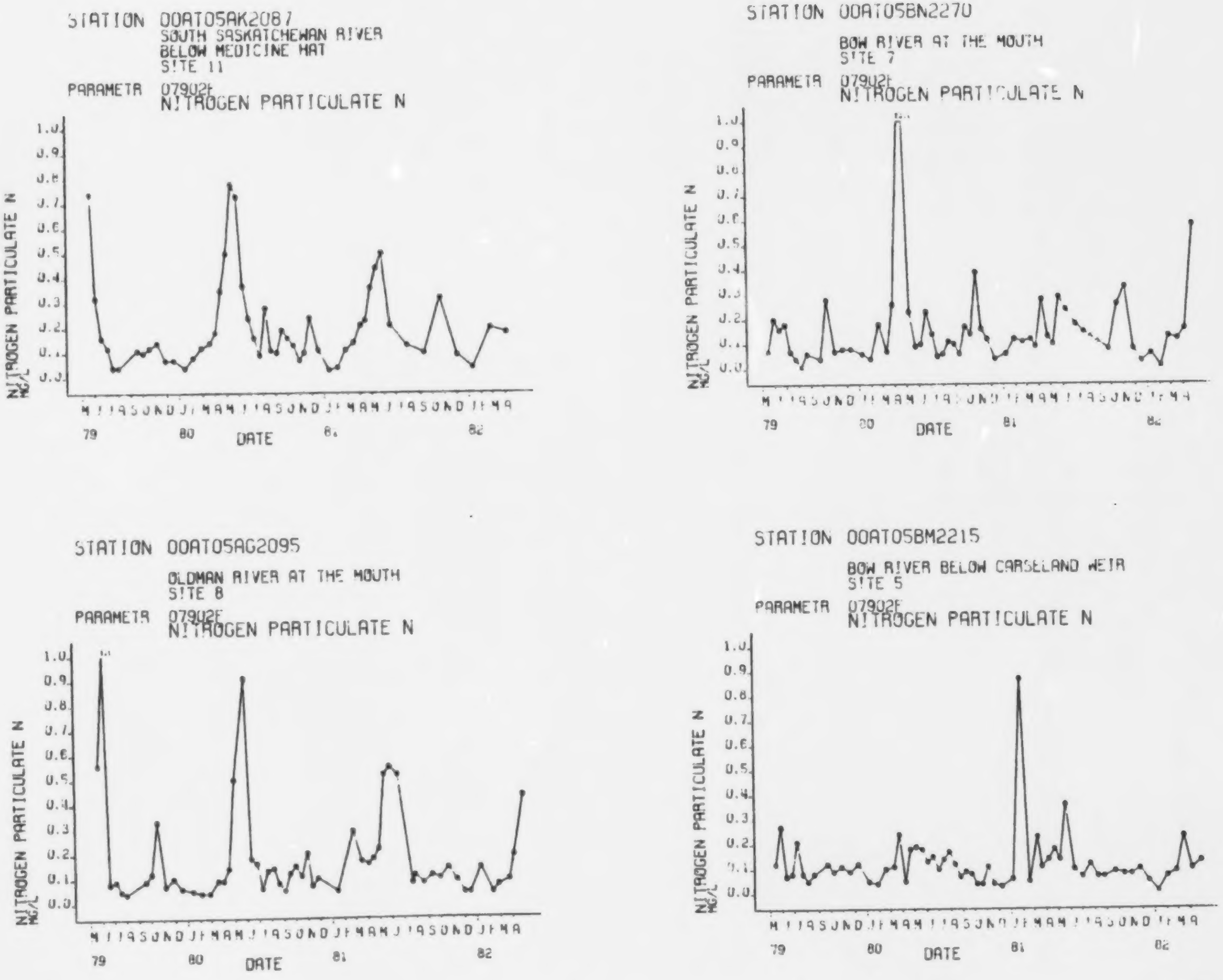

Fig. 18. Comparison of particulate nitrogen data from four sites in the study basin.

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association was tested statistically using the combined data and treating each river separately (Appendix Table A-7). In all three rivers, total inorganic phosphorus and total phosphorus were highly correlated (r = 0.96 - 0.98), as were dissolved reactive phosphorus, dissolved phosphorus and dissolved inorganic phosphorus (r = 0.96 - 0.996). The dissolved forms were more highly correlated to total phosphorus in the Bow (r = 0.88 - 0.99) than in the other two rivers (r = 0.04 - 0.29). The most significant differences between the two groupings occurred during the spring high flow period in the Oldman and South Saskatchewan Rivers.

Data from the Basin were compared between years, and phosphorus concentrations were not significantly different (Table 6) between 1980 and 1981. Seasonal comparison, however, showed that winter values were different between years. When each river was considered separately results were quite different. The Oldman River showed no significant differences between years either annually or seasonally, while the Bow River values were different between years in summer and winter. South Saskatchewan River values were significantly different in every season for either total or dissolved phosphorus.

A second comparison was made between seasons, rather than between years (Table 6). For total phosphorus in the Bow River, spring and fall values were not significantly different, while summer and fall values were similar in the Oldman and South Saskatchewan Rivers. Seasonal comparisons for dissolved phosphorus were close to those of total phosphorus. In addition, summer and fall values for the Bow River, and spring and fall values for the Oldman River, were not significantly different.

Phosphorus concentrations throughout the Basin generally followed an annual pattern of high values in winter and low values in summer (Figure 19, 20 and Appendix Table B-1). There were, however, distinct differences between the rivers. For the purposes of description of trends, total and dissolved phosphorus concentrations will be discussed.

3.11.1 Bow River

At Site 1 above Calgary, phosphorus concentrations were low compared to all other Bow River sites, and annual patterns were not apparent. Total phosphorus fluctuated between 0.003 and 0.018 mg/L through the study period with a slightly higher average seasonal concentration in spring. Dissolved phosphorus remained at detection levels (0.003 mg/L) throughout most of the year.

Two longitudinal trends were apparent at the sites below Calgary. First, Site 2, consistently, had the highest phosphorus concentrations, and these concentrations decreased at each successive site downstream. Second, the annual pattern of high and low concentrations was slightly modified by the lengthening of time that low summer values were recorded at each downstream site.

At Site 2 highest total phosphorus concentrations were measured in November or December (from 0.43 mg/L in 1980 to 0.80 mg/L in 1979) and lowest concentrations (< 0.10 mg/L) were measured from May to August in different years. These peak high values were not maintained for long periods. The concentrations decreased from the peak winter value to relatively constant levels for most of the winter before

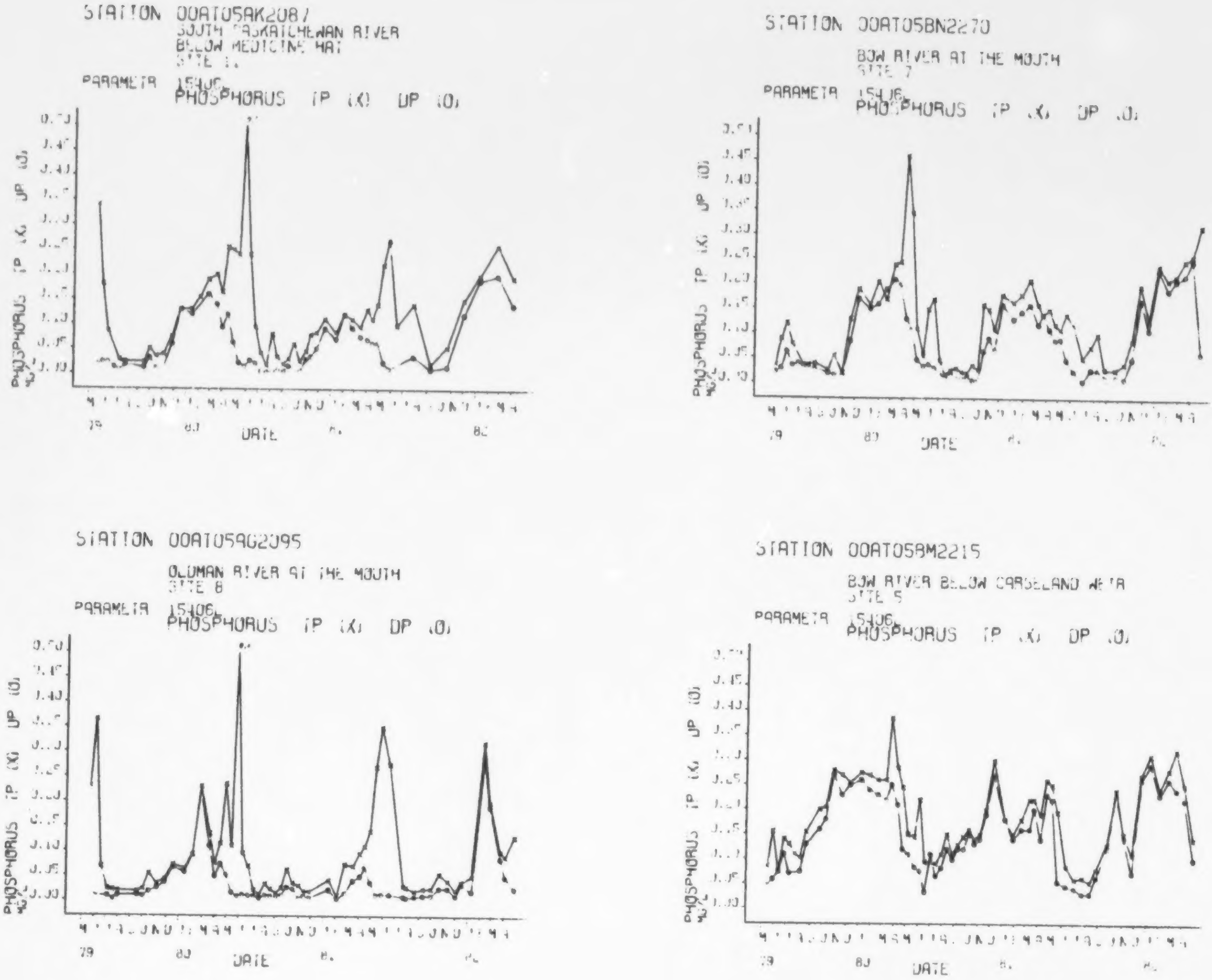

Fig. 19. Comparison of total and dissolved phosphorus data from four sites in the study basin.

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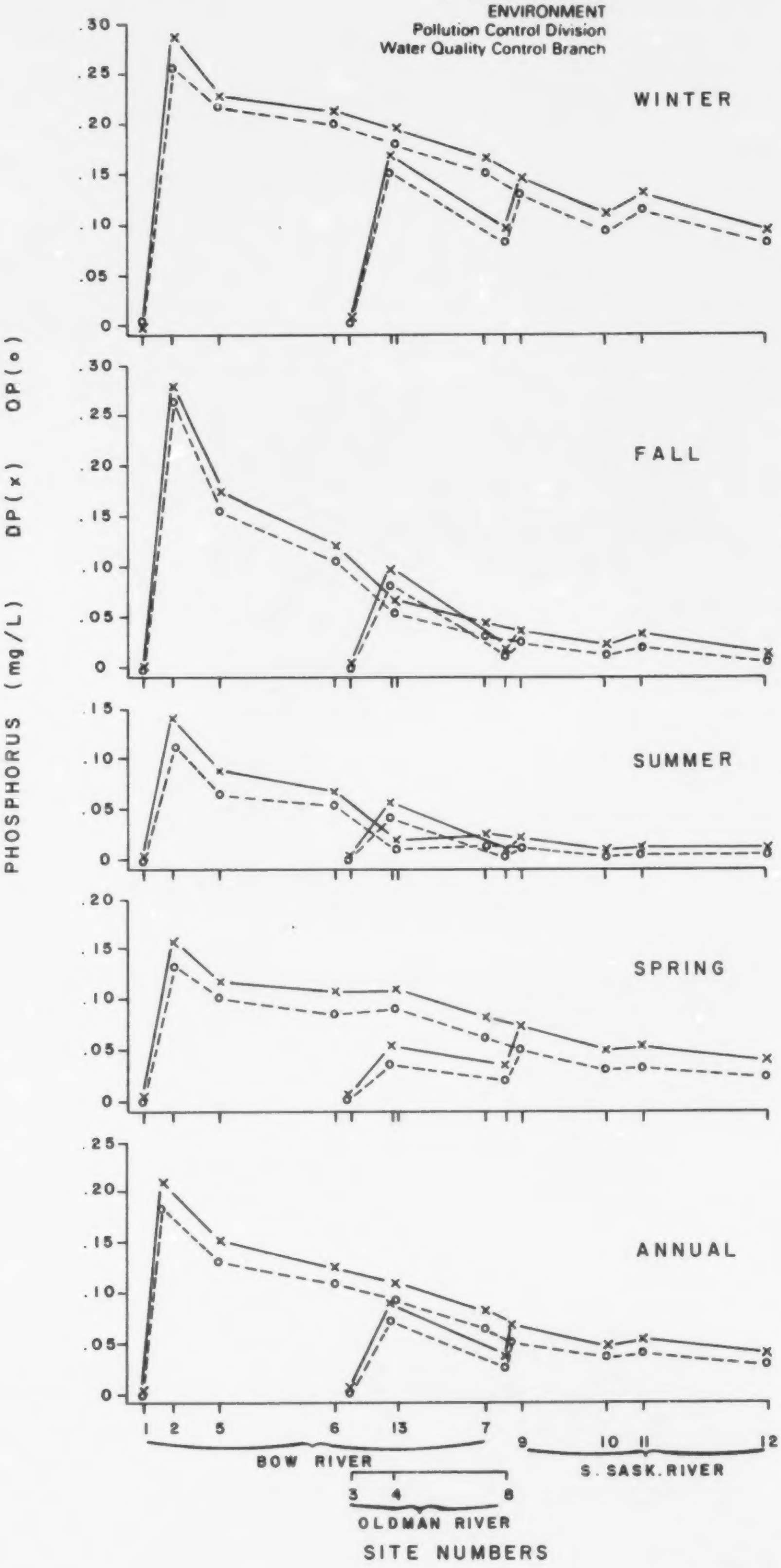

Fig. 20 : Annual and seasonal average concentrations of dissolved (DP) and dissolved reactive (OP) phosphorus data at each site in the study basin.

decreasing rapidly to low values in spring. The increase in concentrations from the low values to late summer/fall values was less consistent between years. In 1979, phosphorus increased from May through June, then decreased to low values for July and August before increasing to the December peak. In 1980, the concentration increased from a low in early June to constant levels for the months of September and October. There was also a small peak value in mid-July. In 1981, the low concentration was measured in early August and the increase to December was broken only by a drop in concentration in mid-November.

Concentrations of dissolved phosphorus followed the same trends as total phosphorus at Site 2, except in summer 1981, when they decreased to low levels earlier (May through July).

Total phosphorus concentrations at Site 5 below the Carseland weir increased less rapidly from summer low values (less than 0.05 mg/L) to winter high values than at Site 2 (Figure 19). In 1979, concentrations increased from August through October. Winter values of about 0.27 mg/L (with a peak total phosphorus value of 0.43 mg/L in April) decreased through spring 1980 to a low in June. Phosphorus concentrations in 1980 rose steadily from June to October, climbed rapidly to peak in December (0.30 mg/L), decreased to mid-January and increased again until April 1981. The summer low in 1981 extended through June and July. Concentrations rose from August to peak at 0.24 mg/L in October, dropped again in November before increasing to winter values of 0.24 to 0.32 mg/L. Dissolved phosphorus concentrations followed the total phosphorus trends except in the spring when they decreased to low values more rapidly.

Trends in phosphorus concentrations at Site 6 (below Bassano Dam) were similar to those at Site 5, though the concentration increase in the fall of 1979 was later, and did not reach winter values until December. Absolute values were generally lower (Appendix Table B-1). In addition, peak total phosphorus concentrations (greater than 0.40 mg/L) were measured in March and October 1981, but dissolved phosphorus did not show corresponding peaks.

Sites 13 and 7 showed similar trends in phosphorus concentration, with Site 7 concentrations slightly lower (Figure 19, 20 and Appendix Table B-1). Summer low values (averaging 0.042 mg/L) were separated from winter high values (averaging 0.202 mg/L) by rapid concentration changes. Spring and fall total phosphorus concentrations were less consistent between sites, and averaged 0.199 and 0.127 mg/L at Site 13 and 0.177 and 0.074 mg/L at Site 7, respectively.

As with concentrations at other sites, values of dissolved and total phosphorus diverged in spring, when those of dissolved phosphorus decreased before those of total phosphorus. There were also peak concentrations in total phosphorus at Site 13 in October 1980 and 1981, which dissolved phosphorus did not have. The decrease in dissolved phosphorus concentration began in March 1980 and in April 1981. This type of yearly variation results from variation in climate, discharge and biological activity.

3.11.2 Oldman River

Low phosphorus concentrations were measured above Lethbridge (Site 3) and the highest concentrations were measured below Lethbridge (Site 4). Values at Site 8 were less than those at Site 4. The relative peak value below Lethbridge was, however, much lower than that below Calgary in the Bow River.

Total phosphorus at Site 3 stayed at relatively low levels (0.01 - 0.03 mg/L) for most of the year. There were peak values in June 1979, in April to July and December 1980, and in February and April to June 1981 (Appendix Table B-1). Dissolved phosphorus did not have the same peak values but fluctuated from detection level (0.003 mg/L) to 0.019 mg/L.

At Sites 4 and 8 large peak values in total phosphorus concentration (greater than 0.3 mg/L) were measured in June 1979, May 1980 and May/June 1981. High values of total phosphorus, when dissolved phosphorus was also high, were measured throughout the winters of 1980 and 1982; there were peak values in January/February of both years (Figure 19, 20 and Appendix Table B-1). The 1981 winter peak value did not develop significantly. Concentrations of total phosphorus were lowest at Site 4 in July, and followed peak values immediately. In 1979 and 1981, concentrations increased until September and stayed relatively constant until November before increasing again. In 1980, phosphorus declined from September to November and increased to slightly higher concentrations in winter 1981. Concentrations of dissolved phosphorus deviated from total phosphorus trends in the spring. Dissolved phosphorus decreased to low values from May to July, when total phosphorus concentrations increased.

At Site 8 general trends in phosphorus concentration were similar, but values stayed lower for longer periods than at Site 4 (Figure 19). Phosphorus values at Site 8 remained below 0.05 mg/L from July to December for total phosphorus and from May to December for dissolved phosphorus.

3.11.3 South Saskatchewan River

Phosphorus concentrations in the South Saskatchewan River combine trends shown in the Bow and Oldman Rivers. Low concentrations of dissolved phosphorus were measured from May to October with a rapid increase in late fall to higher winter values (0.094-0.146 mg/L). These values decreased again in spring (Figure 19, 20 and Appendix Table B-1). Very large differences between total and dissolved phosphorus were measured from March to July, with total phosphorus values peaking, while dissolved phosphorus values decreased.

From upstream to downstream, concentrations of phosphorus decreased along the length of the river, with the exception of the site below Medicine Hat. However, the increase in phosphorus at Site 11 was much lower than those below the other two major cities.

3.11.4 Ratio of Phosphorus Forms

The ratios of several phosphorus forms were calculated both annually and seasonally (Table 7). Overall, the ratios of total inorganic phosphorus (TIP) to total phosphorus (TP), dissolved

TABLE 7 ANNUAL AND SEASONAL RATIO OF PHOSPHORUS FORMS IN THE BASIN OVERALL AND IN EACH RIVER SEPARATELY. VALUES MEASURED AT THE DETECTION LIMIT OF 3 μg/L WERE INCLUDED AND GIVEN THE VALUE 2.9 μg/L

ANNUAL	TIP/TP	DIP/DP	OP/DP
Basin	.79	.78	.69
Bow	.83	.85	.78
Oldman	.75	.75	.63
S. Saskatchewan	.75	.67	.57
SPRING			
Basin	.82	.76	.64
Bow	.84	.84	.77
Oldman	.81	.68	.52
S. Saskatchewan	.81	.68	.53
SUMMER			
Basin	.67	.69	.60
Bow	.73	.77	.65
Oldman	.64	.74	.67
S. Saskatchewan	.56	.50	.46
FALL			
Basin	.75	.74	.65
Bow	.81	.84	.77
Oldman	.72	.76	.63
S. Saskatchewan	.66	.55	.46
WINTER			
Basin	.90	.92	.86
Bow	.92	.95	.92
Oldman	.82	.85	.72
S. Saskatchewan	.92	.93	.85

inorganic phosphorus (DIP) to dissolved phosphorus (DP) and dissolved reactive phosphorus (OP) to dissolved phosphorus were 0.79, 0.78 and 0.69, respectively, and ratios in the Bow River were higher than those in the Oldman and South Saskatchewan Rivers. Seasonally, lowest ratios were measured in summer and highest ratios were measured in winter. The only exceptions were the low spring ratios of dissolved inorganic to dissolved phosphorus, and dissolved reactive to dissolved phosphorus, in the Oldman River.

The ratio of dissolved phosphorus to total phosphorus was calculated at each site both annually and seasonally (Figure 21). On an annual basis, Bow River sites had a larger component of dissolved phosphorus than Oldman and South Saskatchewan River sites. On a seasonal basis, however, Site 4 below Lethbridge, in summer and fall, had high ratios of dissolved to total phosphorus relative to Sites 13 and 7 in the Bow River. Overall, seasonal trends throughout the Basin are shown by combining data for each season from each site. Winter ratios were highest, and averaged 0.81, followed by fall (0.63), summer (0.52) and spring (0.43).

Sites 1 and 3, upstream of Calgary and Lethbridge, respectively, had lower ratios than Sites 2 and 4, downstream of each of these cities, respectively (Figure 1). The relationship between upstream and downstream sites was not as evident around Medicine Hat. The change in ratios at downstream sites was quite different between the rivers and between the seasons.

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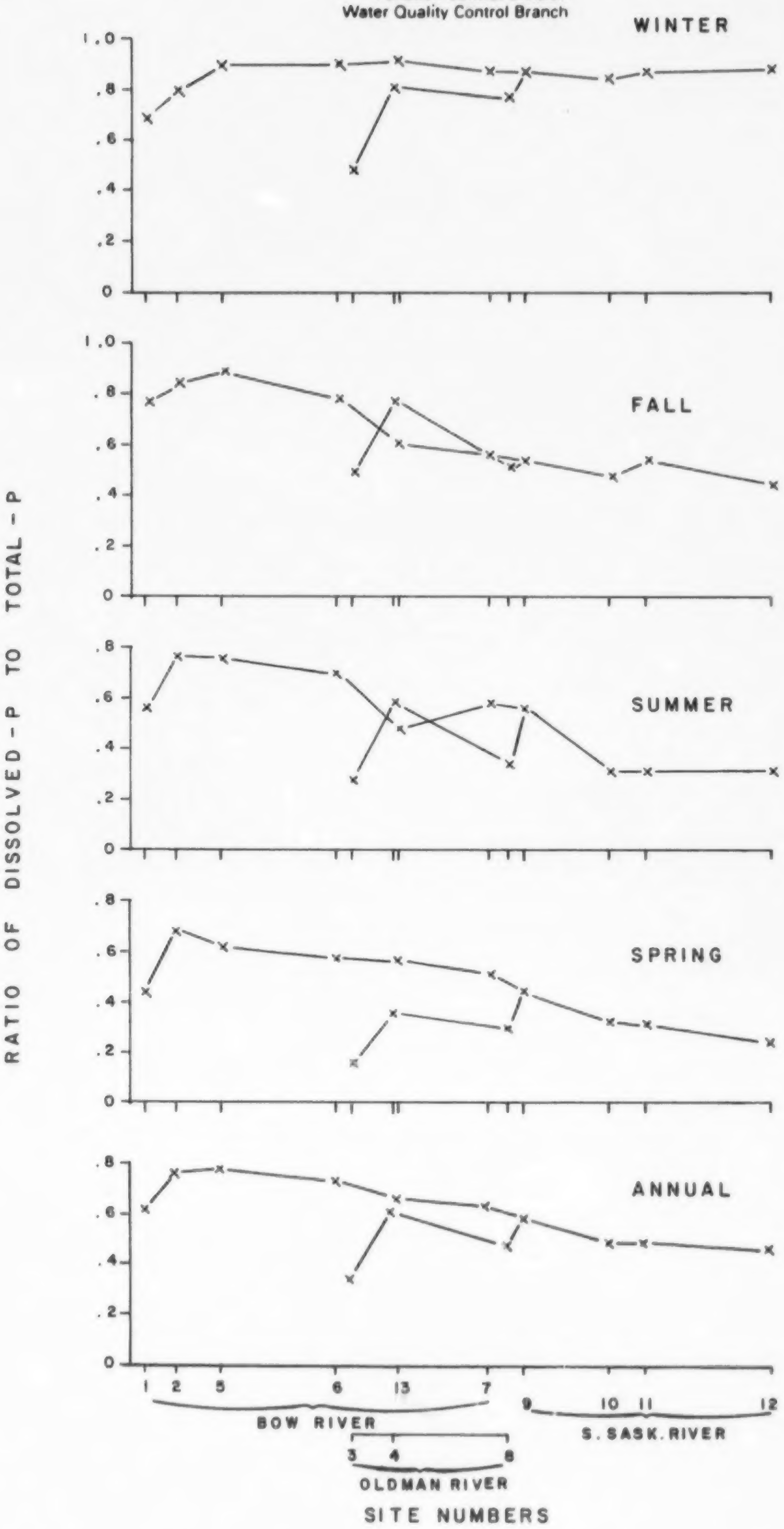

Fig. 21 : Annual and seasonal average ratios of dissolved phosphorus to total phosphorus at each site in the study basin.

The ratio of dissolved to total phosphorus was highest relative to other sites on the Bow River in the same season at Site 2 in spring and summer, but continued to increase below Site 2 in fall and winter before decreasing at downstream sites. This decrease was more pronounced in summer and fall than in spring, and in winter the ratio stayed relatively constant from Site 5 to Site 7.

In the Oldman River the ratio of dissolved to total phosphorus decreased below Site 4, but to a much smaller degree in winter than in other seasons. In the South Saskatchewan River, this ratio was relatively more constant than in the Bow or Oldman Rivers.

3.12 Biologically-Available Phosphorus

3.12.1 Dissolved

Dissolved, biologically-available phosphorus (DBAP) is highly correlated with dissolved reactive, dissolved inorganic and dissolved phosphorus for each of the three rivers ($r = 0.90$ to 0.94). These relationships are summarized as ratios in Table 8. The strong correlation means that any of the three forms of dissolved phosphorus can be used to predict dissolved biologically-available phosphorus.

The variable number of total data points between rivers reflects a difference in the number of sampling sites on each river. Seasonal variation in sample size (from 6 to 63) reflects the time distribution of sample collection and the exclusion of values at and below detection limit, since these were not used in ratio calculations. The summer and fall samples sizes for the Oldman and South Saskatchewan

TABLE 8 RATIO OF BIOLOGICALLY AVAILABLE PHOSPHORUS FORMS TO CHEMICALLY MEASURED PHOSPHORUS FORMS. VALUES AT THE DETECTION LIMIT WERE NOT USED IN RATIO CALCULATIONS.

		DBAP/UP			DBAP/DIP			DBAP/DP			PBAP/PP	
		Avg Ratio	n	Mean	Avg Ratio	n	Mean	Avg Ratio	n	Mean	Avg Ratio	n
ANNUAL	Bow	1.25	(138)	116+ 108	1.03	(143)	112 111	0.82	(150)	106+ 119	0.52	(162)
	Oldman	1.82	(40)	53+ 39	0.99	(48)	43 39	0.79	(56)	39 43	0.32	(86)
	SSR	1.61	(78)	61+ 49	1.07	(90)	52+ 48	0.69	(114)	43+ 49	0.43	(112)
WINTER	Bow	1.14	(30)	190+ 174	1.09	(30)	190 180	1.05	(30)	190 187	0.63	(40)
	Oldman	2.11	(9)	66+ 47	1.22	(8)	65 55	1.10	(10)	60 59	0.46	(20)
	SSR	1.26	(21)	109+ 91	1.08	(21)	109 100	0.99	(21)	109 107	0.64	(24)
SPRING	Bow	1.08	(63)	99 97	0.96	(62)	99 104	0.77	(63)	95+ 117	0.46	(62)
	Oldman	1.81	(16)	53+ 36	1.02	(19)	45 40	0.74	(22)	39 44	0.26	(31)
	SSR	1.94	(38)	49+ 38	1.26	(41)	44 41	0.82	(44)	42+ 53	0.40	(41)
SUMMER	Bow	1.93	(24)	76+ 58	1.10	(28)	61 55	0.69	(33)	54+ 63	0.51	(35)
	Oldman	1.11	(8)	53 45	0.81	(10)	42 41	0.76	(12)	38 41	0.29	(17)
	SSR	0.93	(6)	7 6	0.26	(12)	1+ 4	0.32	(25)	4+ 10	0.32	(27)
FALL	Bow	1.10	(21)	110 107	1.04	(23)	105 106	0.84	(24)	101+ 117	0.53	(25)
	Oldman	2.25	(7)	38+ 25	0.94	(11)	26 25	0.66	(12)	24 29	0.30	(18)
	SSR	1.16	(13)	47+ 34	1.14	(16)	39+ 31	0.55	(23)	27+ 33	0.40	(20)

+indicates significant difference between means ($p < 0.05$)

Rivers, in particular, are reduced because of the frequent occurrence of dissolved reactive phosphorus and dissolved inorganic phosphorus concentrations of less than 3 µg/L.

Annually, there is a significant difference between dissolved, biologically-available phosphorus and dissolved reactive phosphorus for all three rivers. The greatest deviation between forms occurred in the Oldman River, and least deviation in the Bow River, while South Saskatchewan River results were intermediate. Seasonal means were significantly different for eight of twelve possible comparisons. The greatest deviation between dissolved, biologically-available phosphorus and dissolved reactive phosphorus for the Bow River occurred in summer. However, this average ratio is weighted by two extreme values. When these values are removed, the ratio is decreased from 1.93 to 1.18. Ratios for the Oldman River were greatest in fall and winter, then declined through spring to a summer low. In the South Saskatchewan, maximal difference occurred during spring.

The data show that dissolved, biologically-available phosphorus and dissolved, inorganic phosphorus values were generally most similar. The only data sets tested, which were significantly different, were those from the South Saskatchewan River on an annual basis, and again in summer and fall. Over the testing period average ratios ranged from 0.99 (Oldman) to 1.07 (South Saskatchewan) on an annual basis, though a greater range of ratios was measured when data were treated seasonally.

Annually, dissolved biologically-available phosphorus was significantly less than dissolved phosphorus for each river, with average ratios of 0.69 to 0.82. A distinct pattern showed that dissolved biologically-available phosphorus closely approximated dissolved phosphorus in winter months. In other seasons, most of the dissolved phosphorus concentrations exceeded those of dissolved, biologically-available phosphorus.

3.12.2 Sephadex-Gel Filtration

Only 10 of 18 samples analyzed by Sephadex-gel filtration contained sufficient phosphorus to carry out the procedure. Comparison of orthophosphorus determined by Sephadex filtration and dissolved reactive phosphorus by chemical analysis on the same water (Figure 22) indicated very close correlation (r = 0.996). Washing out (elution) of higher molecular weight phosphorus compounds (HMWP), which frequently caused the error in the orthophosphorus technique, did not occur in any of the March samples. Trace quantities of high molecular weight phosphorus were apparent and chemically analyzed as dissolved reactive phosphorus in the summer samples. This material was observed at void volume (molecular weight greater than 5000) but represented less than 5 µg/L and therefore comprised only a fraction of the total measured dissolved reactive phosphorus.

3.12.3 Particulate

Particulate phosphorus (PP) was generally less available for biological uptake in the Oldman River and more available in the Bow River; South Saskatchewan River values were intermediate (Table 8).

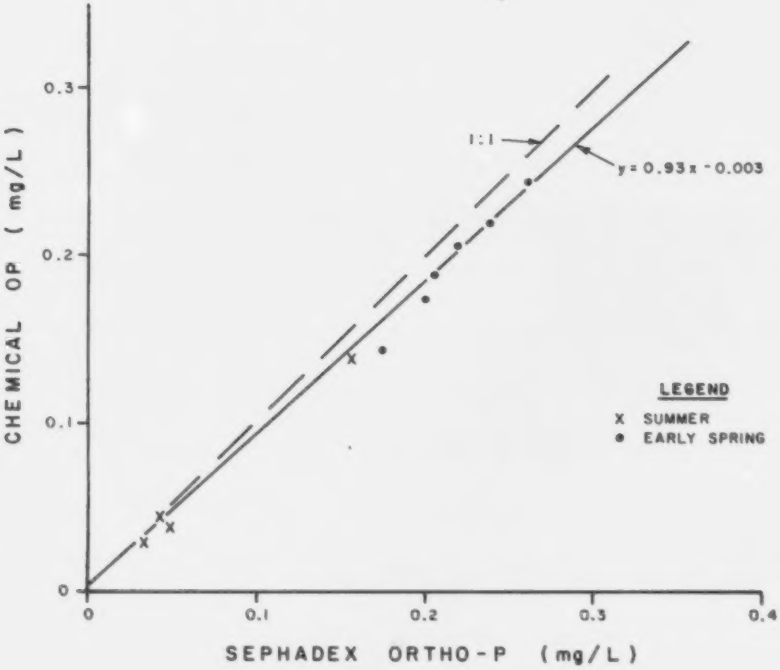

Fig. 22 Comparison between measurements of dissolved reactive phosphorus by chemical analysis and orthophosphorus by Sephadex gel filtration.

Seasonally, ratios of particulate biologically-available phosphorus (PBAP) to particulate phosphorus were higher in winter than in the other seasons.

When particulate phosphorus availability was investigated at each site separately, several trends were apparent (Figure 23). Low availability was shown at Site 1 upstream of Calgary. Site 3 upstream of Lethbridge had the lowest annual value of all sites studied. Generally, particulate phosphorus availabilities increased downstream of each of the three major urban centres, though this trend was least consistent in winter. Ratios further downstream of Calgary and Lethbridge were inconsistent between seasons, but stayed relatively constant on an annual basis. Highest particulate phosphorus availability in the South Saskatchewan River was measured at Site 9 below the confluence of the Bow and Oldman Rivers. Downstream on the South Saskatchewan River, proportions were lower and generally similar between sampling locations.

The relationship between particulate phosphorus availability (PBAP/PP) and three variables; particulate organic carbon, dissolved, biologically-available phosphorus and the ratio of particulate to total phosphorus; was tested. Though there was no relationship between availability and particulate organic carbon ($r = 0.09$), there was a significant linear relationship with dissolved, biologically-available phosphorus ($r = 0.37$) and the ratio of particulate to total phosphorus ($r = -0.46$). Scattergrams of these relationships using seasonal average values are given in Figure 24. When particulate phosphorus comprised a major proportion of total

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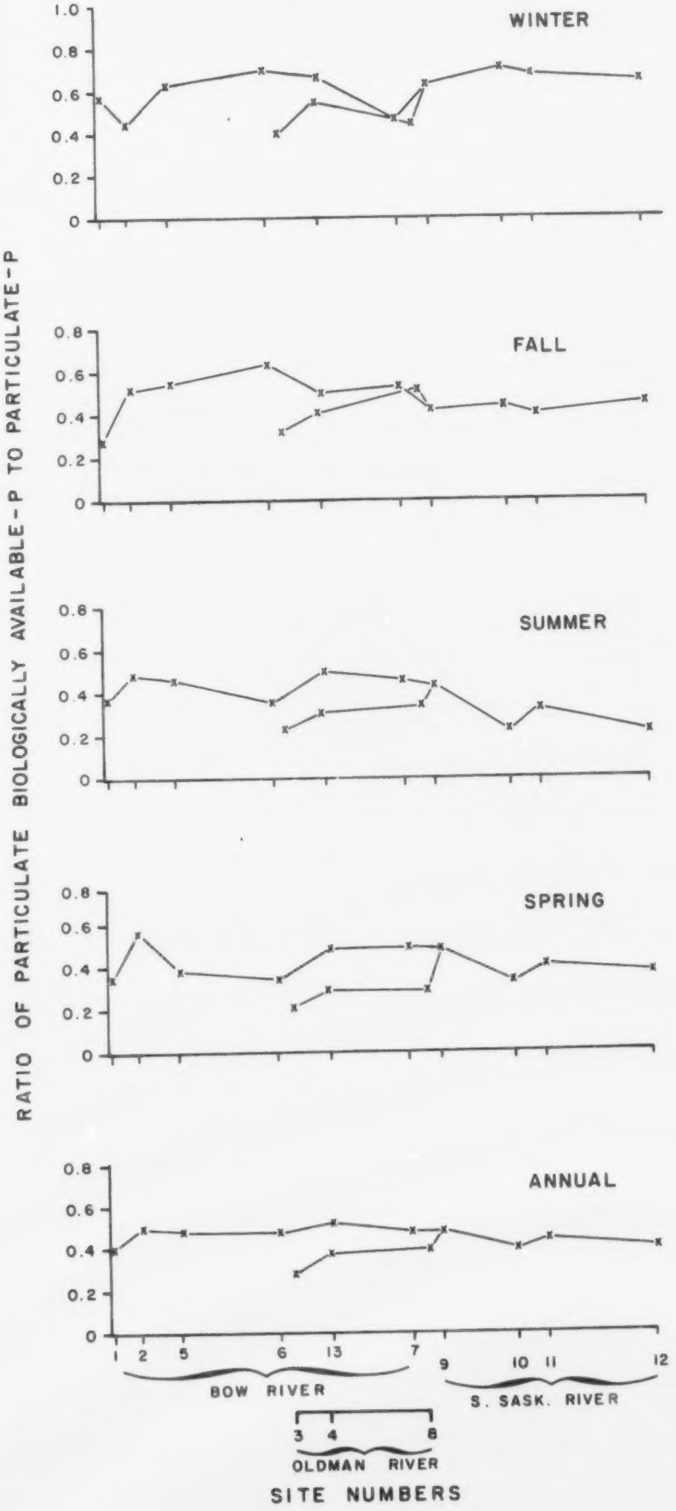

Fig. 23 : Annual and seasonal average ratios of particulate biologically available phosphorus to particulate phosphorus at each site in the study basin.

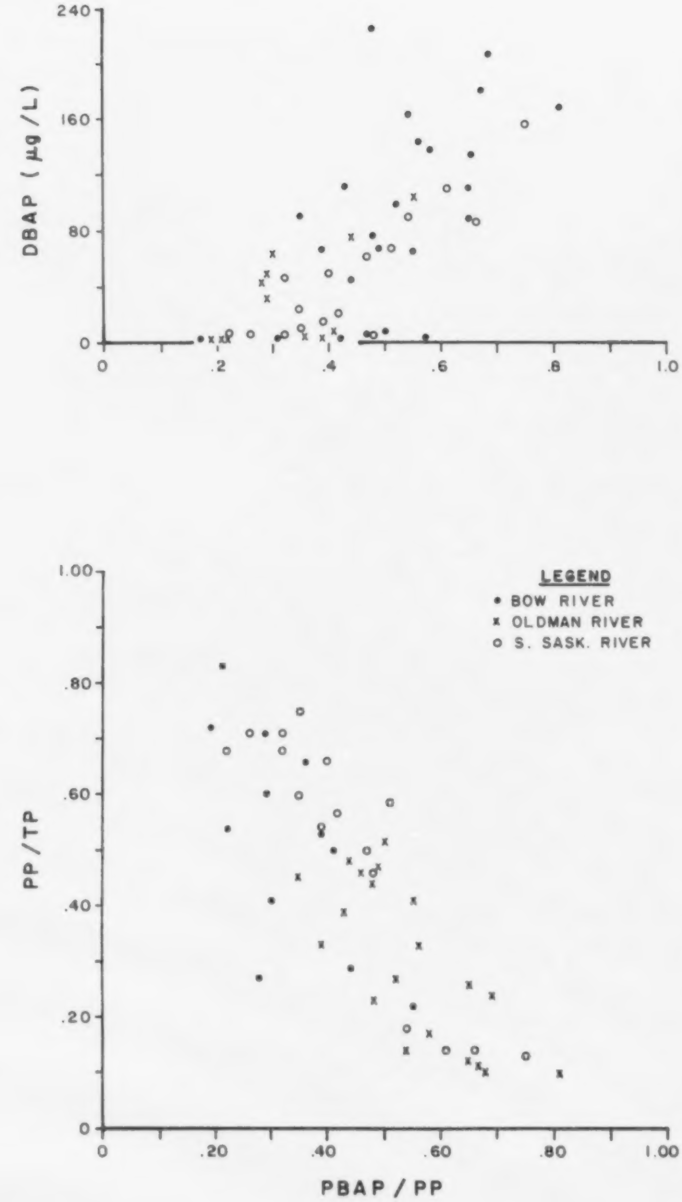

Fig. 24: Comparisons of the ratios of particulate biologically available phosphorus to particulate phosphorus, to the ratios of particulate phosphorus to total phosphorus, and to dissolved biologically available phosphorus.

phosphorus (0.60 - 0.85), availability was generally low (0.20 - 0.40). Availability was greatest when particulate to total phosphorus proportions ranged between 0.10 and 0.30.

Figure 25 summarizes the division of total phosphorus into biologically-available and unavailable forms, as well as the subdivision of available phosphorus into particulate and dissolved forms for the Basin. Annually, 80 to 90% of the total phosphorus in the Bow River downstream of Calgary is biologically-available. Most of the total biologically-available phosphorus was in the dissolved form (77-85%), since quantities of particulate phosphorus, though highly available, were small.

A very different relationship between phosphorus forms and availability occurred in the Oldman River, where more total phosphorus was in the particulate form. Dissolved, biologically-available phosphorus provided 68 to 82% of the total biologically-available phosphorus, but the overall availability of the total phosphorus transported in the Oldman River was less than in the Bow River (51-75%).

Overall proportion of biologically-available phosphorus in the South Saskatchewan River was about 70%, except for a higher percentage (82%) at Site 9. Phosphorus availability patterns in the South Saskatchewan reflected the combined effect of the two source rivers, that is, high dissolved, biologically-available phosphorus input from the Bow, and high particulate phosphorus from the Oldman. Calgary and Lethbridge had a significant influence on downstream phosphorus availability patterns in their respective rivers. The effect of Medicine Hat on the South Saskatchewan River was not as significant.

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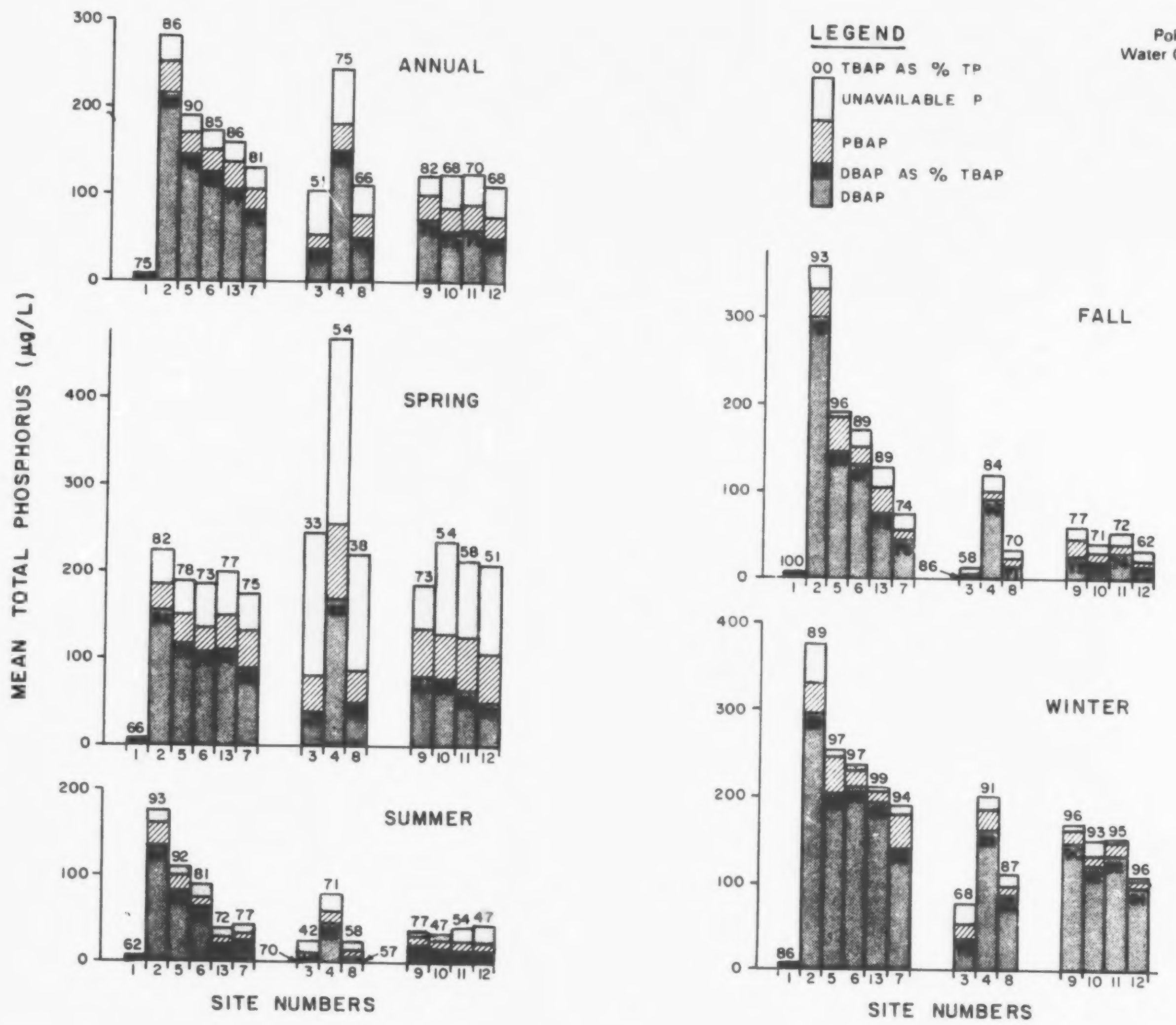

Fig. 25 Comparison of annual and seasonal average values for biologically available phosphorus forms and total phosphorus at each site in the study basin.

Seasonal fluctuation of total phosphorus availability was least in the Bow River. However, there was generally lower availability throughout the river during spring and in the downstream reaches during summer and fall. Almost all the winter total phosphorus in the Bow River downstream of Calgary was readily available. Marked seasonal fluctuation of total phosphorus availability occurred in the Oldman River. Lowest availability was evident for spring months (33-54%), and gradually increased at all sites through summer and fall to a winter maximum. Seasonal total phosphorus availability patterns in the South Saskatchewan River were similar to those of the Oldman River.

3.13 Nutrient Limitation

The ratio of dissolved nitrogen to dissolved phosphorus at each site, annually and seasonally; gave some indication of the relative abundance of the two most common nutrients which limited plant growth (Table 9). Ratios greater than 12 indicated that there was an adequate relative supply of nitrogen available for growth. Absolute concentrations had to be considered in any interpretation of nitrogen to phosphorus ratios.

Site 1 and 3, above Calgary and Lethbridge, had consistently high ratios in all seasons. In the Bow River below Calgary at Sites 2, 5 and 6, ratios ranged between 8 and 11 seasonally. Further downstream at Sites 13 and 7, spring and winter ratios were 10 to 11, and summer and fall ratios were 15 to 26.

TABLE 9 RATIO OF DISSOLVED NITROGEN TO DISSOLVED PHOSPHORUS AT EACH SITE IN THE STUDY BASIN. VALUES BELOW DETECTION LIMITS WERE INCLUDED AS 0.009 MG/L FOR DN AND 2.9 µG/L FOR DP.

SITES	Ratio ANNUAL	SPRING	SUMMER	FALL	WINTER
Bow River					
1	35	37	26	30	44
2	9	9	9	8	8
5	9	10	10	9	8
6	10	9	11	10	9
13	13	10	17	19	10
7	16	11	15	26	11
Oldman River					
3	49	36	40	39	91
4	10	19	8	4	5
8	20	14	34	18	17
S. Saskatchewan River					
9	17	13	18	27	12
10	26	14	31	47	15
11	22	15	28	33	13
12	29	17	29	52	20

In the Oldman River, at Site 4 below Lethbridge, the ratio of dissolved nitrogen to dissolved phosphorus was low (4 to 8) in all seasons except spring, when the ratio was 19. Further downstream at Site 8, ratios ranged from 14 to 34 seasonally, and showed highest values in summer. Ratios in the South Saskatchewan River were generally high, but higher in summer and fall than in winter and spring.

Figure 26 and Appendix Table B-2 show the relationship between algal assay results with and without addition of nitrogen to the growth medium. When addition of nitrogen increased the growth potential, nitrogen was then assessed as limiting growth. When addition of nitrogen did not increase the growth potential, then another nutrient was in short supply. The other nutrient was often phosphorus.

At Sites 1 and 3 above the cities on the Bow and Oldman Rivers, respectively, results from the algal assays were very similar. In the Bow River below Calgary, the two algal assay results were similar only in May/June, but further downstream, by Sites 13 and 7, results were similar from June to September.

Results from the Oldman River below Lethbridge were somewhat different. At Site 4 algal assay results were similar in only May and October, but at Site 8, results were similar for the time period from May to November. In the South Saskatchewan River, results were similar from July to September at Site 9 and from May to October at the three downstream sites.

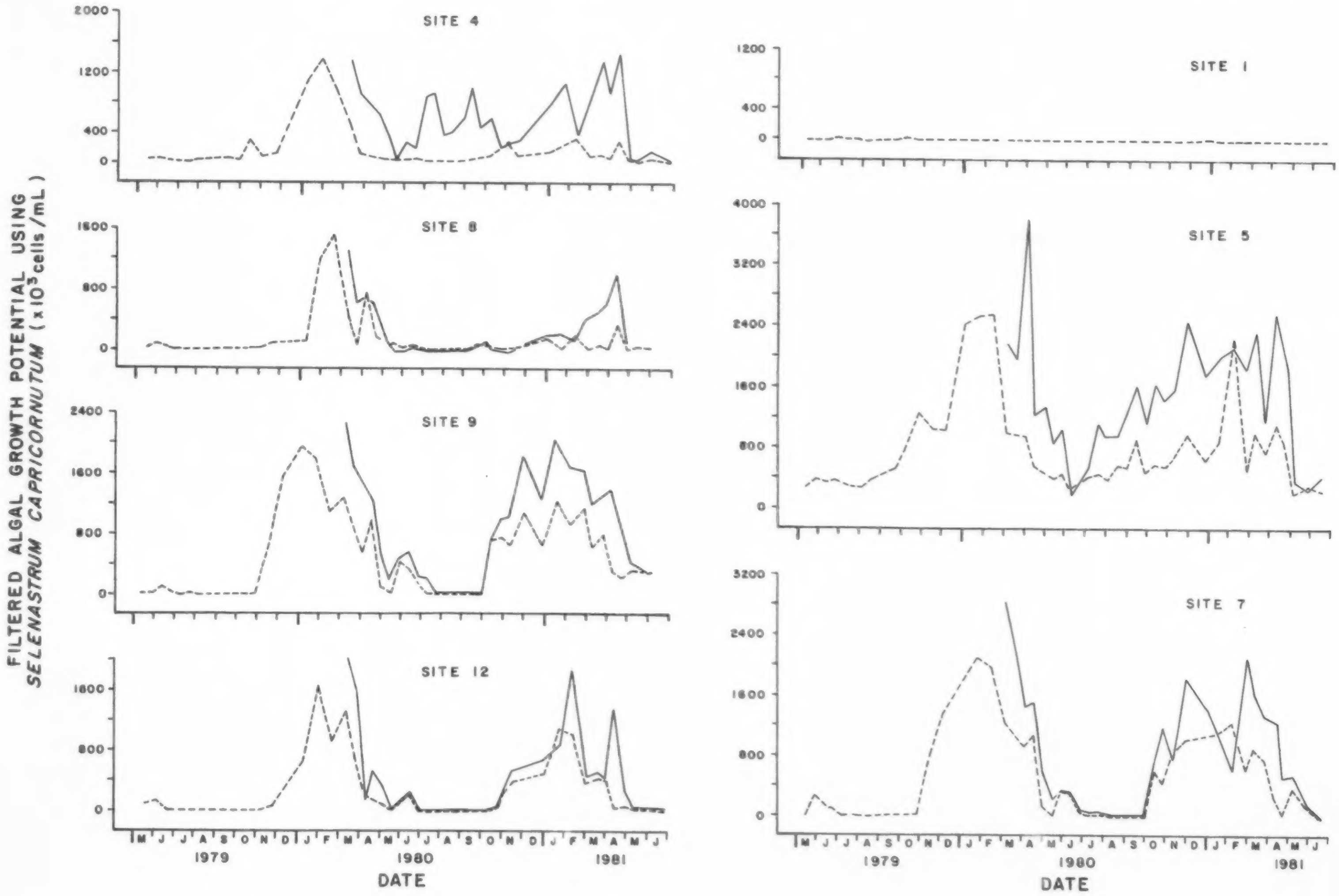

Fig. 26 Comparison of algal growth potential with (——) and without (----) the addition of nitrogen at selected sites in the study basin.

3.14 Historical Nutrient Data

Annual and seasonal concentrations of phosphorus (dissolved and dissolved reactive) and nitrogen (dissolved and nitrate + nitrite) are given in Table 10 for both the historical and this study data. Only three locations - Bow River near its confluence with the Oldman (Site 7), Oldman River above Lethbridge (Site 3) and South Saskatchewan River at Highway 41 (Site 12) - had sufficient data for a seasonal comparison of the nutrient parameters. The small number of samples that contributed to each seasonal mean were not sufficient for conclusions, though tentative comparisons are possible.

The historical data for phosphorus were consistently higher than the study data at Site 3, though values were close to detection. At Sites 7 and 12, annual study phosphorus concentrations were higher than historical concentrations. Seasonally, this relationship held in spring and winter when concentrations were highest, while historical means were often greater than study means in summer and fall.

Historical total phosphorus (TP) data are available for eight study sites in the basin, and a comparison was made with this study data in Figure 27 One extreme total phosphorus value of 8.2 mg/L was deleted from Site 10 data. Historical data were much higher than study data both annually and seasonally.

A comparison of historical and study data for nitrogen (Table 10) showed that historical annual means were greater than study means. Seasonal comparisons showed variable results except during winter when study concentration means exceeded historical means.

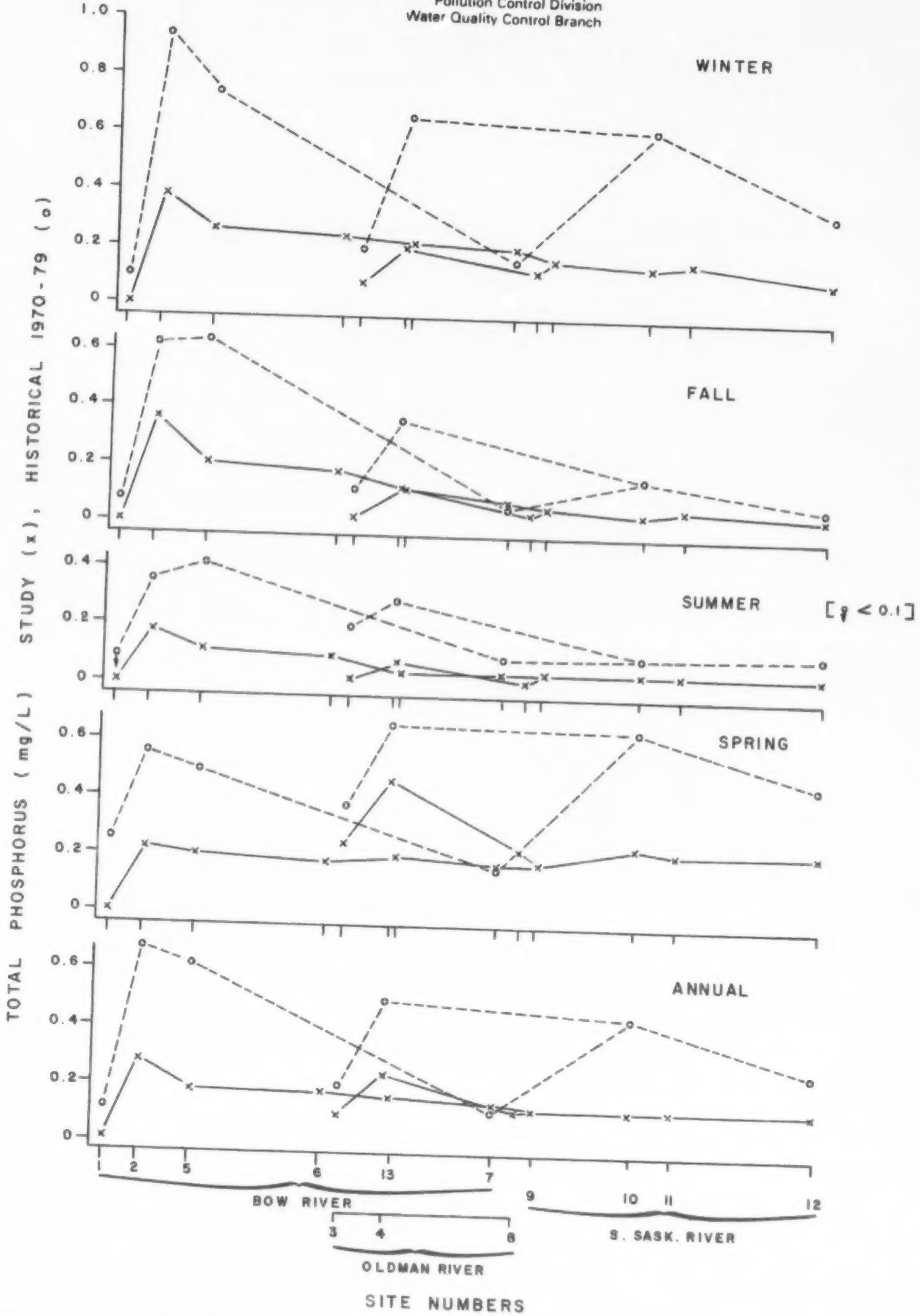

Fig. 27 Comparison of annual and seasonal average concentrations of total phosphorus from study data and from historical data.

TABLE 10 COMPARISON OF STUDY DATA AND HISTORICAL DATA (1970 TO 1979) FOR SELECTED NUTRIENT PARAMETERS

	DP (ug/L)				OP (ug/L)				DN (mg/L)				NIT (mg/L)			
	Study		Hist.		Study		Hist.		Study		Hist.		Study		Hist.	
	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$
Site 3																
Annual	81	6	13	11	81	3	30	12	80	.26	13	.26	81	.12	18	.16
Spring	25	7	3	9	27	3	4	5	27	.23	3	.26	27	.07	3	.07
Summer	17	4	3	10	16	3	6	9	17	.14	3	.26	17	.02	3	.11
Fall	20	5	3	9	20	3	8	4	19	.16	3	.11	19	.04	4	.04
Winter	19	7	4	14	18	4	12	8	17	.53	4	.37	18	.36	8	.29
Site 7																
Annual	86	82	13	67	85	65	29	52	81	.95	13	.98	84	.64	22	.73
Spring	26	82	4	58	26	61	4	32	26	.84	4	1.15	26	.54	4	.57
Summer	20	25	2	19	20	11	5	15	19	.31	2	.27	18	.08	3	.07
Fall	18	44	3	41	18	30	8	34	18	.81	3	.76	18	.57	6	.76
Winter	22	166	4	121	21	151	12	85	19	1.84	4	1.35	22	1.29	9	1.00
Site 12																
Annual	75	40	38	33	75	29	13	28	73	.70	41	.84	75	.48	31	.51
Spring	24	45	11	32	24	24	1	8	23	.56	10	.55	24	.34	8	.40
Summer	15	9	8	12	15	4	4	41	15	.22	9	.25	15	.04	7	.04
Fall	18	12	6	17	18	5	4	26	18	.54	7	.82	18	.33	6	.40
Winter	18	94	13	53	18	81	4	23	17	1.51	15	1.39	18	1.20	10	.98

3.15 Other Water Chemistry Data

Data were collected by Environment Canada during the study period at sites comparable to Sites 1 and 7 in the Bow River, Sites 3 and 8 in the Oldman River, and Site 12 in the South Saskatchewan River (Appendix Table B-3). The annual and seasonal mean values for most variables were comparable with a few exceptions. At Site 3, total phosphorus, turbidity, non-filterable residue, particulate nitrogen and particulate organic carbon from this study data were higher on an annual basis than from Environment Canada's data, a discrepancy which was most pronounced in spring and winter when analyzed seasonally. A similar result was derived for non-filterable residue at Site 8 and Site 12 for spring data. These discrepancies were caused by a different sampling frequency of particulate variables. Study data were collected two to three times more often than Environment Canada's data. Spring and late winter were the times of most dramatic changes in particulate discharge related variables, and the higher sampling frequency in this study was more representative of average conditions at the time of high variation. This was reflected in the annual mean values.

The other exceptions occurred at Site 8 where dissolved phosphorus and chloride were lower for study data, and at Site 7 where silica was higher for study data. Again, these discrepancies were likely caused by sampling frequency, but discrepancies at Site 8 may have resulted because the locations were less comparable than other locations.

3.16 Sediment Phosphorus

Concentrations of total phosphorus in the sediments were lowest at sites upstream of Calgary and Lethbridge and substantially higher downstream, particularly below Calgary (Table 11). Levels decreased with distance downstream from these two major urban areas, and levels measured at Site 10 above Medicine Hat were almost as low as upstream levels. Seasonal variation was greatest below Calgary, and lowest at upstream sites (above Calgary and Lethbridge), and Site 10.

The apatite inorganic phosphorus (AIP) formed the largest fraction of total phosphorus (42% to 79%), but was the least variable both seasonally and between sites. The basin-wide variation in sediment total phosphorus was attributed largely to fluctuating concentrations of the organic (ORGP) and particularly the non-apatite inorganic (NAIP) phosphorus fractions. These fractions followed the same trends as the total phosphorus. They increased markedly below the urban centres, then decreased gradually downstream to low levels at Site 10.

The biologically-available fraction of sediment phosphorus (SBAP) was most similar to non-apatite inorganic phosphorus. The two fractions were highly correlated (r = 0.91) and the ratio of sediment biologically-available phosphorus to non-apatite inorganic phosphorus (ranging from 1.04 to 1.56) indicated that non-apatite inorganic phosphorus underestimated bioavailable sediment phosphorus as measured by algal assays. The least deviation between forms occurred at the first two downstream Calgary sites. Non-apatite inorganic phosphorus

TABLE 11 SUMMARY OF SEDIMENT PHOSPHORUS CONCENTRATIONS (µG/G) AND PROPORTIONAL RELATIONSHIPS BETWEEN FORMS AT EACH SITE. C.V. IS COEFFICIENT OF VARIATION, N=7 EXCEPT AT SITE 1 (N=5). THE ESTIMATE OF AREAL DISTRIBUTION OF FINE PARTICULATE RIVER BOTTOM SEDIMENTS IN SEPTEMBER, 1981 IS ALSO GIVEN.

Site	Total Phosphorus		Apatite Inorganic Phosphorus			Non-apatite Inorganic Phosphorus			Organic Phosphorus			Sediment BAP			Sediment Quantity g dry wt/m^2	
	Mean	C.V.	Mean	C.V.	% of TP	Mean	C.V.	% of TP	Mean	C.V.	% of TP	Mean	C.V.	% of NAIP	Mean	S.D.
Bow River																
1	692	10	548	4	71	59	55	7	92	34	21	83	43	156	32	21
2	1735	34	667	5	42	660	60	35	407	45	23	609	38	104	103	22
5	1117	18	615	6	56	276	49	24	224	35	20	267	41	107		
13	794	19	512	12	65	160	54	19	122	30	15	207	37	142		
7	866	23	567	2	68	147	59	16	151	74	16	163	40	118	185	38
Oldman River																
3	615	11	485	6	79	48	37	8	81	41	13	49	57	113	293	60
4	793	17	534	6	59	151	47	18	108	44	12	233	69	142	368	264
8	770	22	507	5	68	110	74	13	154	59	19	155	82	127		
South Sask River																
10	710	4	530	7	75	90	29	12	81	66	11	119	42	139	297	56

was also highly correlated with dissolved inorganic phosphorus levels in the overlying river water (r = 0.88).

Seasonally, highest concentrations of sediment organic phosphorus, sediment biologically-available phosphorus and non-apatite inorganic phosphorus often occurred in spring samples collected prior to the June high discharge period, while lowest levels were usually detected over the May to August interval (Appendix Figures A-2 to A-4). September and October concentrations were often higher than the summer lows, particularly for sediment organic phosphorus and sediment biologically-available phosphorus.

Estimates of areal amounts of fine particulate river bottom sediment were approximated and were derived from a single set of measurements in September. Spatial trends, however, are shown in these data (Table 11, Sediment Quantity).

The lowest quantity of sediment per substrate area was measured upstream of Calgary, as increasing levels occurred downstream at sequential sites along the Bow River. Overall quantities in the Oldman and South Saskatchewan Rivers are greater than in the Bow River and there is an increase between Sites 3 and 4.

These estimates of sediment quantity were used with average sediment chemistry to calculate relative amounts of phosphorus in the sediment 'pool' of the Bow and Oldman Rivers in fall 1981. The errors in this type of calculation are enormous, nonetheless, they are of interest for broad comparative purposes. The sediment 'pool' for the Bow River from Calgary to its confluence with the Oldman was estimated at 8300 kg total phosphorus, and 2100 kg sediment biologically-available phosphorus. For the Oldman River from Lethbridge to its confluence with the Bow, the sediment 'pool' was estimated at 4600 kg total phosphorus, and 1900 kg sediment biologically-available phosphorus.

The net flux of available phosphorus from the sediments in each reach was calculated by using the average sediment biologically-available phosphorus decline observed from April to July 1981. Values were -1700 kg biologically-available phosphorus for the Bow River, and -1000 kg biologically-available phosphorus for the Oldman River.

3.17 Discharge

Figure 28 shows mean annual discharge in cms (cubic metres/second) and maximum daily discharge in cms from 1900 to 1981 for three Water Survey stations - Bow River at Calgary, Oldman River near Lethbridge and South Saskatchewan River at Medicine Hat. Average mean annual discharges for the period of record to 1979 were 92.1, 90.8 and 206 cms, respectively. The Bow River shows a smaller range of fluctuations than the Oldman River. Maximum daily discharge was variable at all three stations. Higher values were recorded in the Oldman than in the Bow River, and there was a long term trend of decreasing peaks in the Bow River. The South Saskatchewan River reflected the input of both rivers and the peaks in maximum daily discharge were influenced strongly by the Oldman River.

Monthly mean discharge for Bow River at Calgary (Figure 29) showed the yearly variation from 1970 to 1981 and the long-term average. The mean annual discharge exceeded the long-term average

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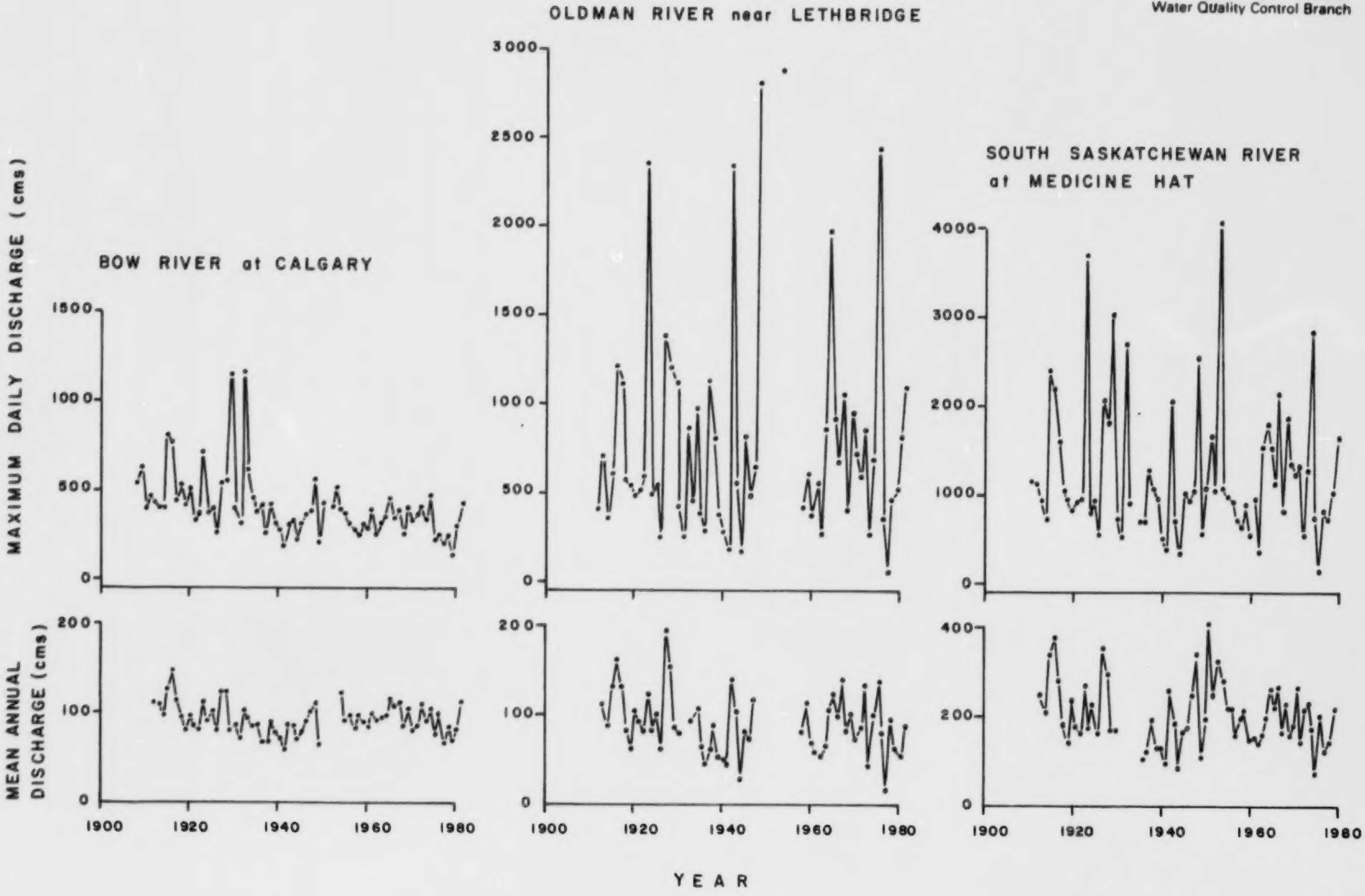

Fig. 28 Comparison of historical discharge values in the Bow, Oldman and South Saskatchewan Rivers.

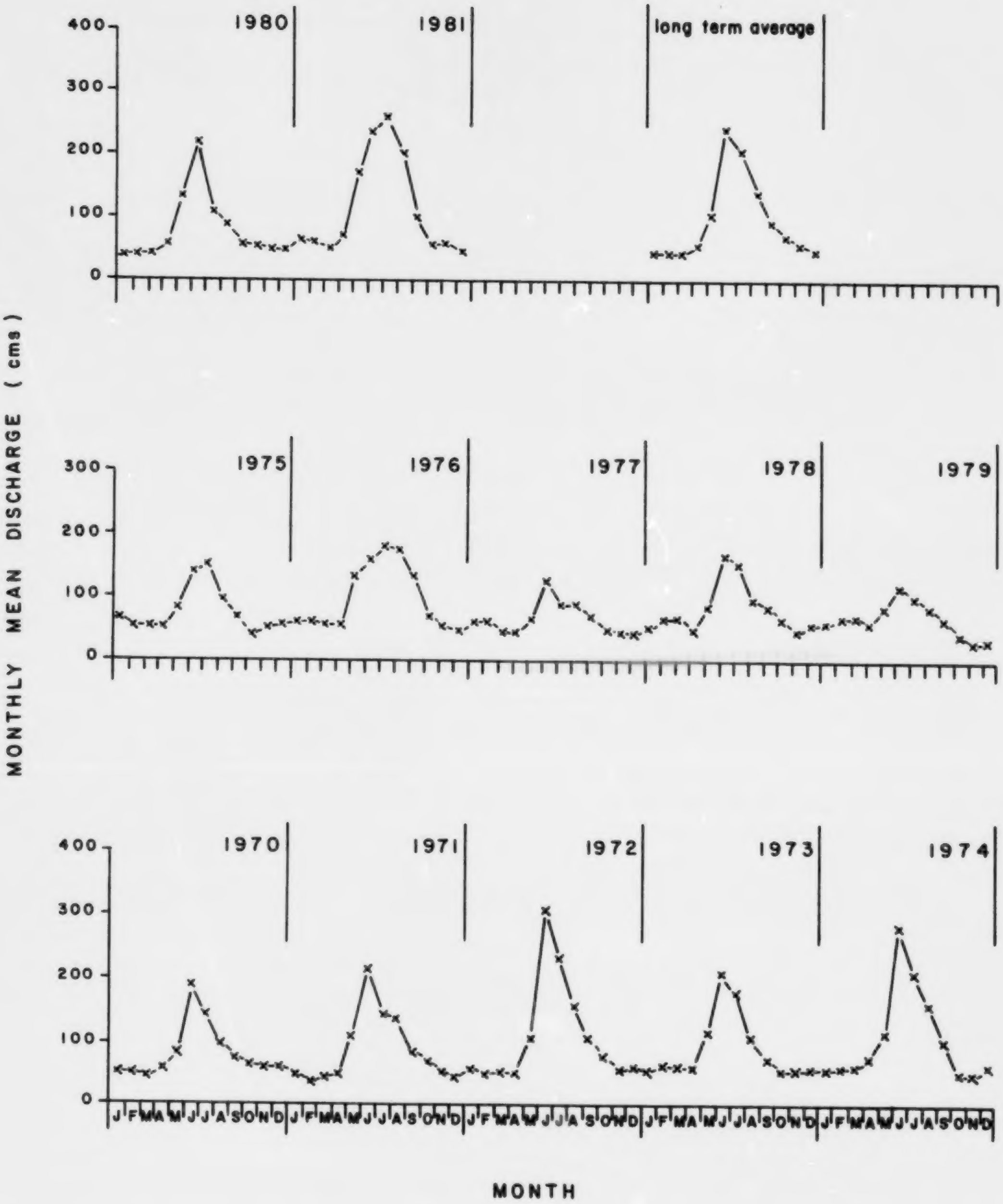

Fig. 29 Monthly mean discharge in the Bow River at Calgary from 1970 to 1981.

during the 1970s only in 1972, 1974 and 1976 (Figure 28). The years of lower than average flow were also reflected in the very low maximum daily discharge values for 1975 to 1979. In fact, the range of values recorded in these five years was equalled in only three previous years on record: 1941, 1944 and 1949.

Pearson's correlations were run between discharge and particulate phosphorus, particulate nitrogen, particulate organic carbon, turbidity, non-filterable residue, dissolved phosphorus and dissolved nitrogen for data from May 1979 to December 1981 (Appendix Table A-8). Combining all the data, the correlations with non-filterable residue (r = 0.59) and turbidity (r = 0.53) were the highest. When the data from each river were treated separately, the correlation with non-filterable residue in the South Saskatchewan River was the strongest (r = 0.82). The highest correlation coefficients with particulate phosphorus, particulate nitrogen and particulate organic carbon were found in the Oldman River (r = 0.63, 0.71 and 0.75, respectively). Correlations with dissolved phosphorus and dissolved nitrogen were weak and negative (r = -.01 to -.30).

3.18 Phosphorus Loading

3.18.1 Site Loading

Figure 30 shows the annual loading in tonnes of total phosphorus (TP) at each site during the study period. Throughout the Basin, the lowest values were measured at Site 1 on the Bow River in both years (22 and 29 tonnes) and the highest values in each year were measured at Sites 10 or 11 in the South Saskatchewan River. In most cases an increase in loading was shown from the upstream to downstream sites

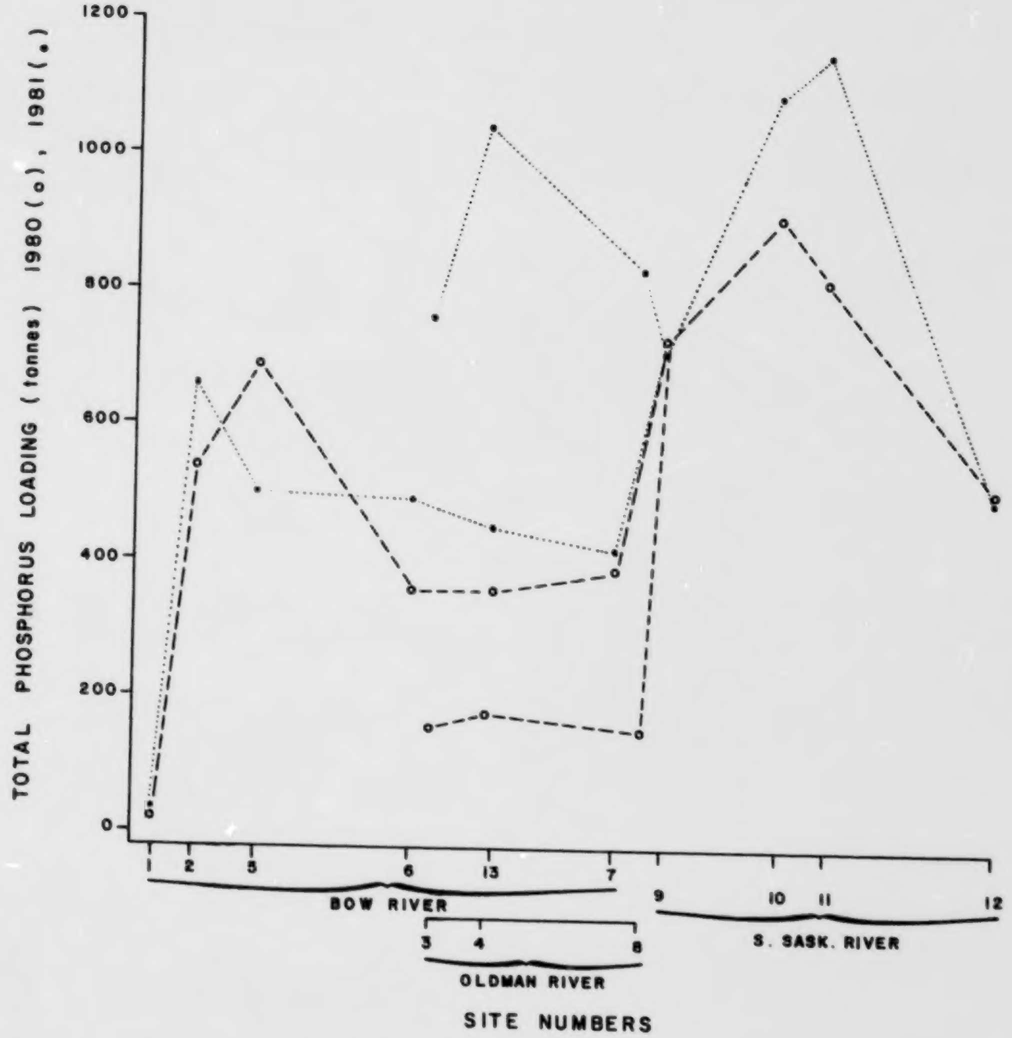

Fig. 30 Comparison of annual loading of total phosphorus in 1980 and 1981 at each site in the study basin.

for each city (Sites 1 to 2 for Calgary, Sites 3 to 4 for Lethbridge and Sites 10 to 11 for Medicine Hat), but the largest such increase was below Calgary. Generally, site loadings decreased in a downstream direction from these high values.

The variation in total phosphorus loading between years was very different for each river. Bow River values were quite similar, while Oldman River values differed dramatically and South Saskatchewan River values were intermediate.

In the Bow River, highest values were measured at Site 2 in 1981 (657 tonnes) and Site 5 in 1980 (688 tonnes). Loading values generally decreased at downstream sites. The coefficient of variation between years (Table 12) ranged from 5% at Site 7 to 23% at Site 5.

In the Oldman River, total phosphorus loading values at Site 3 were higher than those at Site 1 on the Bow River. However, the relative increase to Site 4 was lower than that to Site 2. Loadings decreased to Site 8 in both years. The absolute values were very different between years as 1981 values were five to six times higher than 1980 values (Table 12).

Calculations of total phosphorus loadings in 1980 excluded unusually high concentration of total phosphorus (0.85 - 3.5 mg/L) which were measured on May 27. These high concentrations occurred as a result of the variable deposition of ash over the study basin from the eruptions of Mount St. Helens in Washington. Since this unusual event occurred at a time of high discharge the effect on annual total phosphorus loading calculations was extreme. Had these values been included, total phosphorus loadings in 1980 would have been 1998, 3429 and 737 tonnes at Sites 3, 4 and 8, respectively.

TABLE 12 COMPARISON OF ANNUAL PHOSPHORUS (TP AND DP) LOADING IN TONNES INCLUDING MEAN, STANDARD DEVIATION (SD) AND COEFFICIENT OF VARIATION (CV)

Site	Year	Total Phosphorus				Dissolved Phosphorus			
		Loading	Mean	SD	CV	Loading	Mean	SD	CV
1	1980	21.8	25.6	5.37	21	8.4	9.9	2.12	21
	1981	29.4				11.4			
2	1980	543.7	600.6	80.40	13	461.4	438.4	32.53	7
	1981	657.4				415.4			
5	1980	687.6	592.8	134.14	23	370.8	357.4	19.02	5
	1981	497.9				343.9			
6	1980	359.9	424.4	91.29	22	227.8	236.0	11.60	5
	1981	489.0				244.2			
13	1980	357.2	404.1	66.33	16	191.4	213.0	30.62	14
	1981	451.0				234.7			
7	1980	389.0	404.3	21.64	5	161.6	187.9	37.19	20
	1981	419.6				214.2			
3	1980	155.7	459.2	429.25	93	10.4	22.3	16.83	75
	1981	762.8				34.2			
4	1980	177.5	608.8	609.88	100	47.6	61.2	19.23	31
	1981	1040.0				74.8			
8	1980	149.6	488.8	479.70	98	38.0	44.4	9.12	21
	1981	828.0				50.9			
9	1980	731.2	718.7	17.68	2	174.2	237.0	88.81	37
	1981	706.2				299.8			
10	1980	909.2	999.8	128.20	13	162.3	181.8	27.65	15
	1981	1090.5				201.4			
11	1980	816.7	983.6	235.96	24	178.4	196.9	26.16	13
	1981	1150.4				215.4			
12	1980	510.4	505.0	7.64	2	147.8	152.6	6.79	4
	1981	499.6				157.4			

Total phosphorus loading in the South Saskatchewan River was consistent between years (Table 12), but longitudinal patterns were different. In 1980, total phosphorus loading at Site 9 was greater than those of Sites 7 and 8 combined, while the opposite was true in 1981. Loadings increased to Site 10 in both years, but decreased to Site 11 in 1980 and increased in 1981. Loading at Site 12 was very consistent between years and showed a decrease from Site 11. The total phosphorus loading in 1981 had been adjusted, however, to remove the effect of one very high total phosphorus concentration during high flow. This deletion changed the annual total phosphorus loading from 2683 to 500 tonnes.

Annual and seasonal loading in tonnes of dissolved phosphorus (Figure 31) were calculated using all samples, unlike the total phosphorus loading values discussed above. The variability in dissolved phosphorus loading between years (Table 12) was generally lower than for total phosphorus loading, and the Bow River was the least variable, while the Oldman River was the most variable.

In the Bow River, dissolved phosphorus loading increased from low values at Site 1 to highest values at Site 2 and generally decreased in a downstream direction. The exception to this trend occurred in spring 1980 and 1981 when loadings increased from Site 2 to Site 5. Downstream of Site 5, not only the absolute loading decreased in a downstream direction, but also the rate of the reduction decreased, as indicated by the slope of the lines joining two sites. Seasonally, winter decreases in loading were smallest, while summer decreases were largest.

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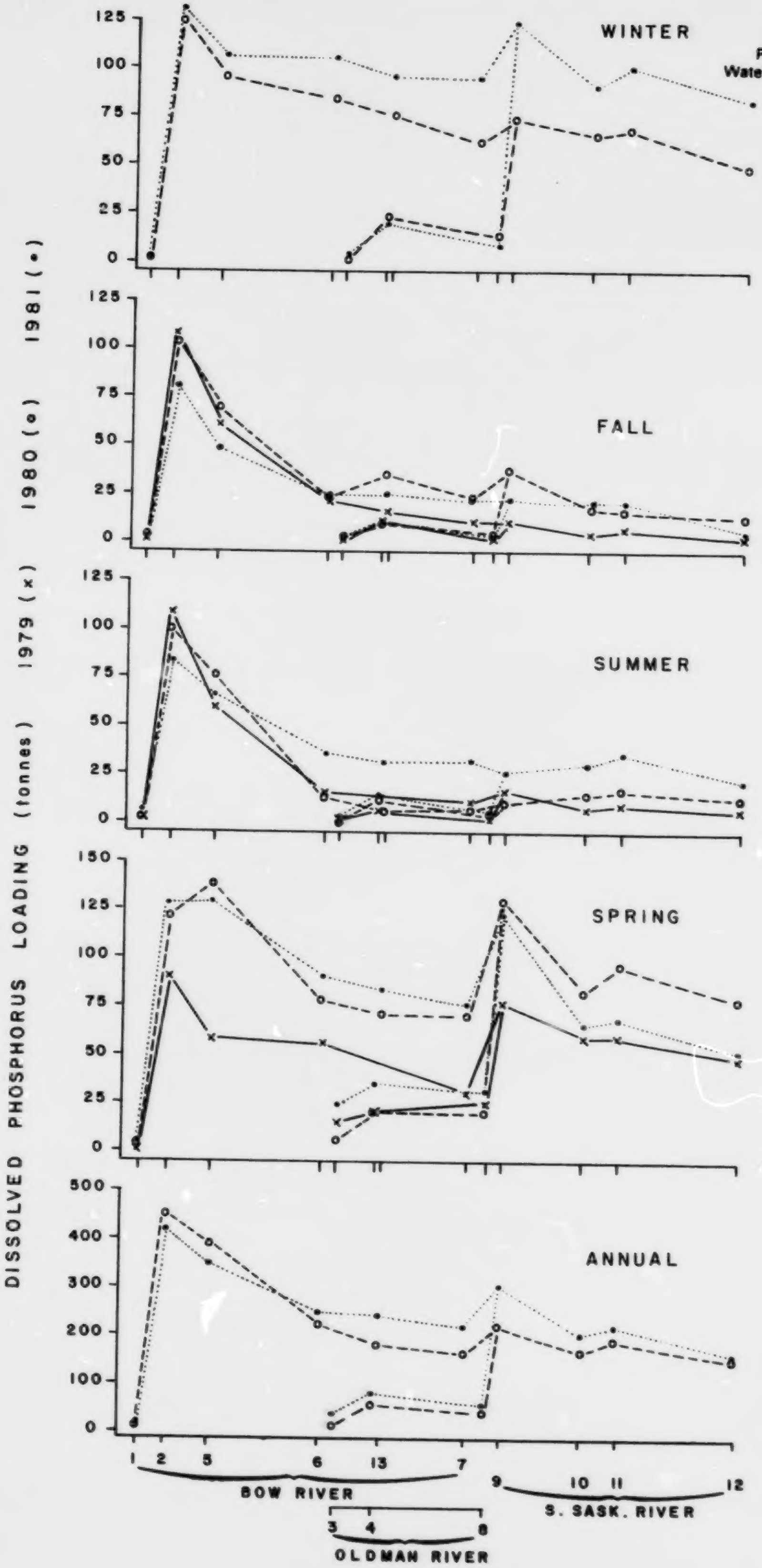

Fig. 31 Comparison of annual and seasonal loading of dissolved phosphorus at each site in the study basin.

In the Oldman River the dissolved phosphorus loadings were much lower than in the Bow River. There was an increase in loading from Site 3 to 4, followed by a decrease to Site 8. Site 9 on the South Saskatchewan River represents the addition of loadings from the Bow and the Oldman Rivers. The overall decrease in loading from Site 9 to Site 12 was at approximately the same rate as from Sites 13 to 7 in the Bow and Sites 4 to 8 in the Oldman, although there was an increase in dissolved phosphorus loading measured between Sites 10 and 11 in most cases.

Variation between years, considering seasonal dissolved phosphorus loading (Table 13), was highest overall in summer and lowest in winter. In the Bow River, Sites 2 and 5 showed highest variation in spring and fall while at downstream sites summer was the most variable between years. In the Oldman River at Sites 4 and 8, summer dissolved phosphorus loadings were most variable and fall values were least variable. In the South Saskatchewan River spring loading values were least variable between years at all sites.

A comparison of loading values calculated from the study data with data collected by Environment Canada (Appendix Table A-9) showed wide discrepancies for both total phosphorus (average coefficient of variation = 28%) and dissolved phosphorus (average coefficient of variation = 24%). This variation resulted from different sampling frequencies with differences in the discharge values sampled and the concentrations measured. A similar comparison was made between loading values from the study data and from the study data plus Environment Canada's data (Appendix Table A-9). In these cases

TABLE 13 COMPARISON OF SEASONAL DISSOLVED PHOSPHORUS LOADING IN TONNES INCLUDING MEAN, STANDARD DEVIATION (SD) AND COEFFICIENT OF VARIATION (CV)

Site	Spring			Summer			Fall			Winter		
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
1	2.4	0.91	38	3.6	1.50	41	1.2	0.32	26	1.4	0.05	4
2	113.3	19.62	17	96.6	12.75	13	97.0	14.33	15	127.1	4.62	4
5	108.6	44.25	41	66.4	7.99	12	59.0	9.98	17	101.0	8.31	8
6	74.9	17.55	23	21.1	12.13	57	21.6	0.51	2	93.9	15.96	17
13	77.5	9.67	12	18.2	17.54	97	25.0	9.57	38	85.4	14.62	17
7	59.1	25.11	42	15.7	13.06	83	18.9	7.26	38	78.1	22.78	29
3	15.9	8.92	56	1.0	0.38	37	0.6	0.35	56	1.7	1.51	87
4	26.4	8.37	32	9.8	3.29	34	9.9	0.55	6	21.8	1.69	8
8	25.8	5.34	21	3.1	1.43	46	2.6	0.97	4	10.9	3.58	33
9	109.8	28.54	26	17.3	7.47	43	23.4	13.89	59	98.4	35.08	36
10	69.1	12.18	18	17.0	11.40	67	14.1	8.16	58	77.9	17.59	23
11	74.8	19.56	26	19.6	13.89	71	14.6	6.22	43	84.0	23.43	28
12	59.7	15.78	26	13.1	7.72	59	7.2	5.68	79	67.3	25.60	35

discrepancies in loading values were generally higher for total phosphorus (average coefficient of variation = 10%) than for dissolved phosphorus (average coefficient of variation = 7%). The variation between loadings from the two data sets was generally less than the variation between the two years of study data at each site, particularly for dissolved phosphorus loadings.

3.18.2 Loading Sources

Over the past ten years the municipal input of phosphorus has changed as have populations. The City of Calgary grew from about 400,000 in 1971 to 590,000 in 1981 (Figure 32). The population growth was paralleled by an increase in sewage treatment plant effluent volume from 48 to 88 million gallons per day. From 1971 to 1974 the sewage treatment plant phosphate loading decreased, probably because of the restriction of phosphates in the manufacture of detergents. However, the loading increased since 1974, and exceeded the 1971 value in 1980. Lethbridge and Medicine Hat, with similar growth patterns, would show the same trends.

The form of phosphorus and its bioavailability are factors in determining the importance of sewage effluent as a loading source. Samples of effluent from Calgary's Bonnybrook sewage treatment plant were analyzed for phosphorus forms in connection with a study of diurnal variability (Appendix A). The phosphorus discharged from the plant was primarily in the dissolved form (90-97%), in which dissolved reactive phosphorus accounted for more than 90% of the soluble forms.

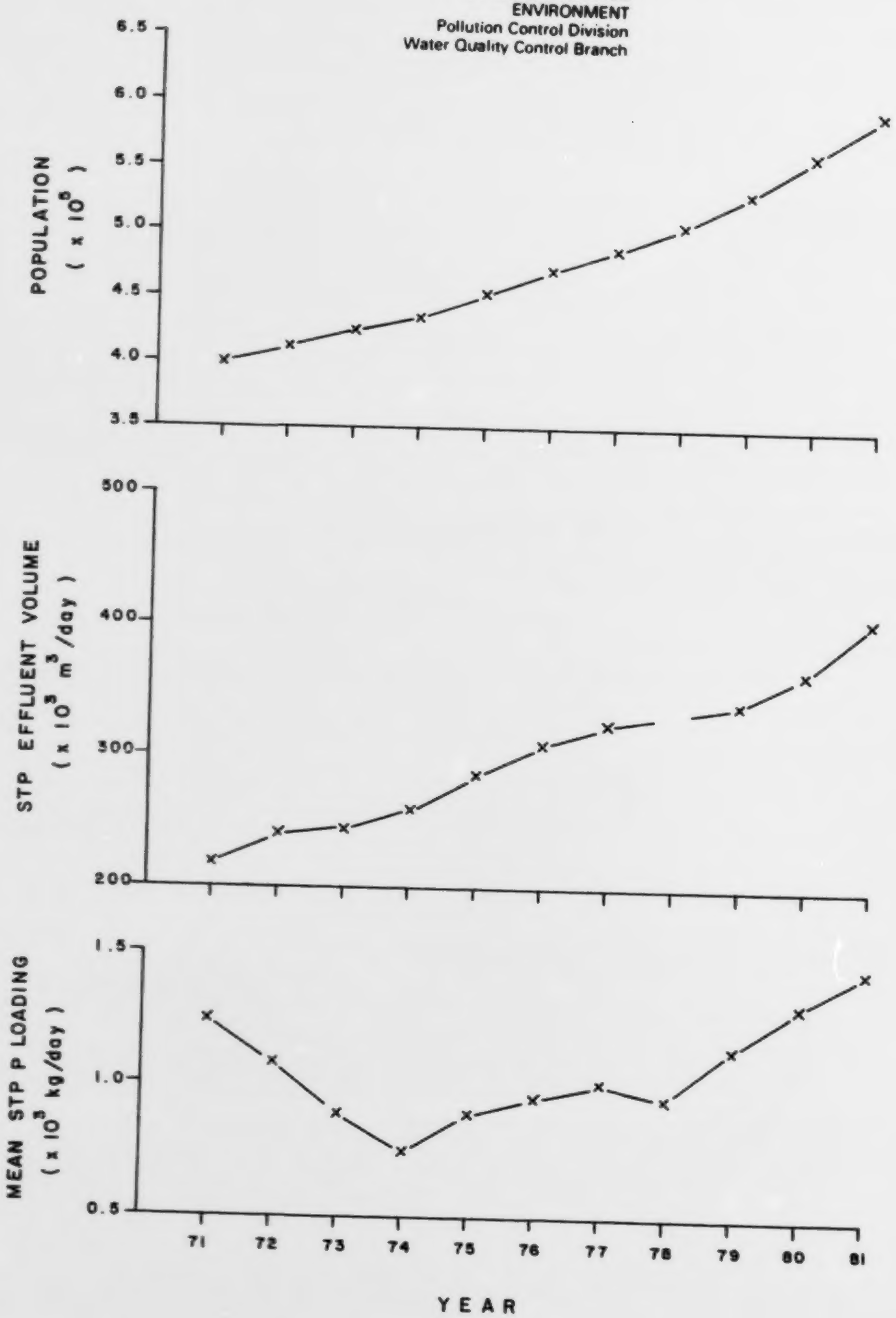

Fig. 32 Population and sewage treatment plant effluent volume and phosphorus loading for Calgary from 1971 to 1981.

A few dissolved biologically-available phosphorus estimates were carried out on sewage effluent in another study. Dissolved biologically-available phosphorus appeared to correlate fairly well with dissolved reactive phosphorus, both prior to and after alum precipitation (Figure 33). The large dissolved biologically-available phosphorus standard deviations may be caused partially by problems intrinsic to carrying out algal assays at very high nutrient levels (Hamilton et al., 1981). Extremely limited data on particulate phosphorus availability of Calgary sewage effluent (Table 14) suggested that particulate phosphorus availability in the effluent is low and may decrease after alum precipitation.

In order to compare the relative effects of the phosphorus loading from each city on its receiving river, total phosphorus dilution concentrations were calculated (Figure 34). These dilution concentrations represented the mixing of sewage treatment plant effluent with river water. Also shown for comparison are the measured mean summer dissolved phosphorus concentrations below the city inputs. Dissolved phosphorus was used for comparison to remove the bias in river water concentrations that resulted from seasonal fluctuations in total phosphorus in the Basin. Calgary has the highest dilution phosphorus concentrations, followed by Lethoridge and Medicine Hat. A large yearly variation was illustrated more strongly in the Calgary and Lethbridge data than in the Medicine Hat data. The effects of a low flow year such as 1977 were shown in high dilution

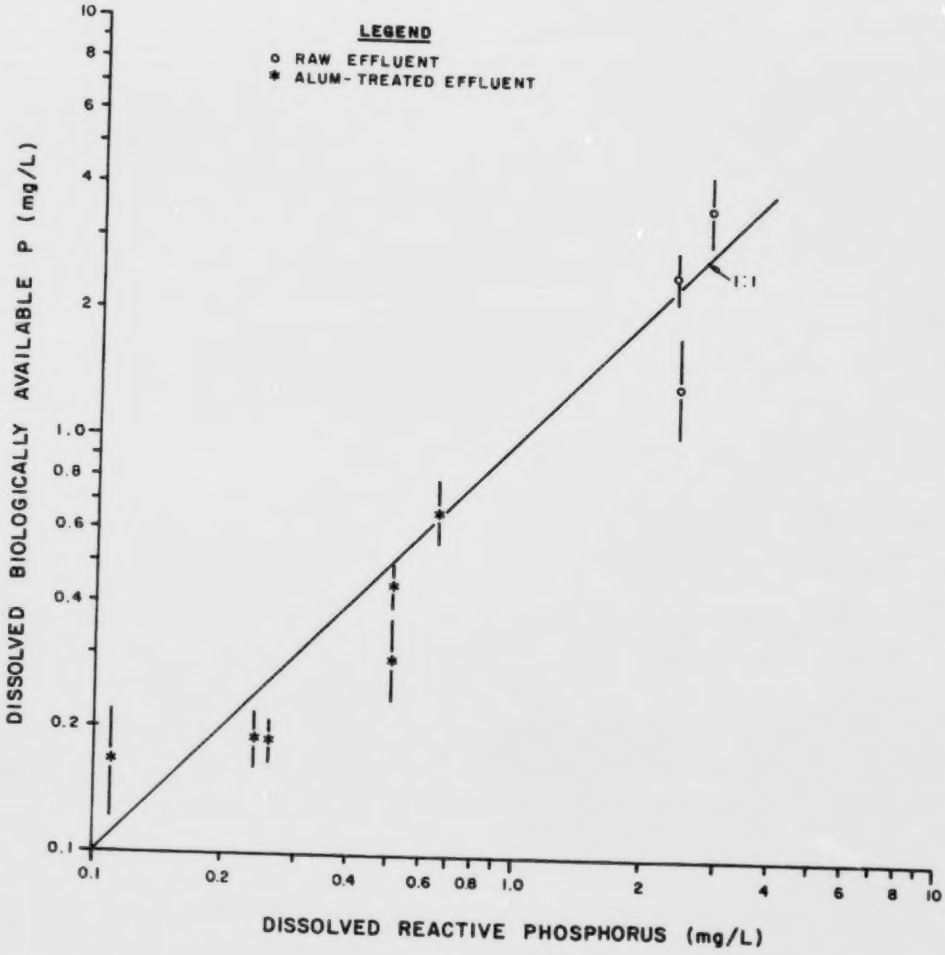

Fig. 33 Comparison between dissolved biologically available phosphorus and dissolved reactive phosphorus in sewage effluent.

TABLE 14 BIOAVAILABILITY OF PARTICULATE PHOSPHORUS IN SEWAGE TREATMENT PLANT EFFLUENT

	PARTICULATE BAP*	S.D.	TOTAL PARTICULATE PHOSPHORUS*	PBAP/PP
Raw Secondary	24.5	2.2	120	0.20
60 mg/L alum	14.6	1.5	870	0.02
100 mg/L alum	17.6	3.4	480	0.04

* µg/L

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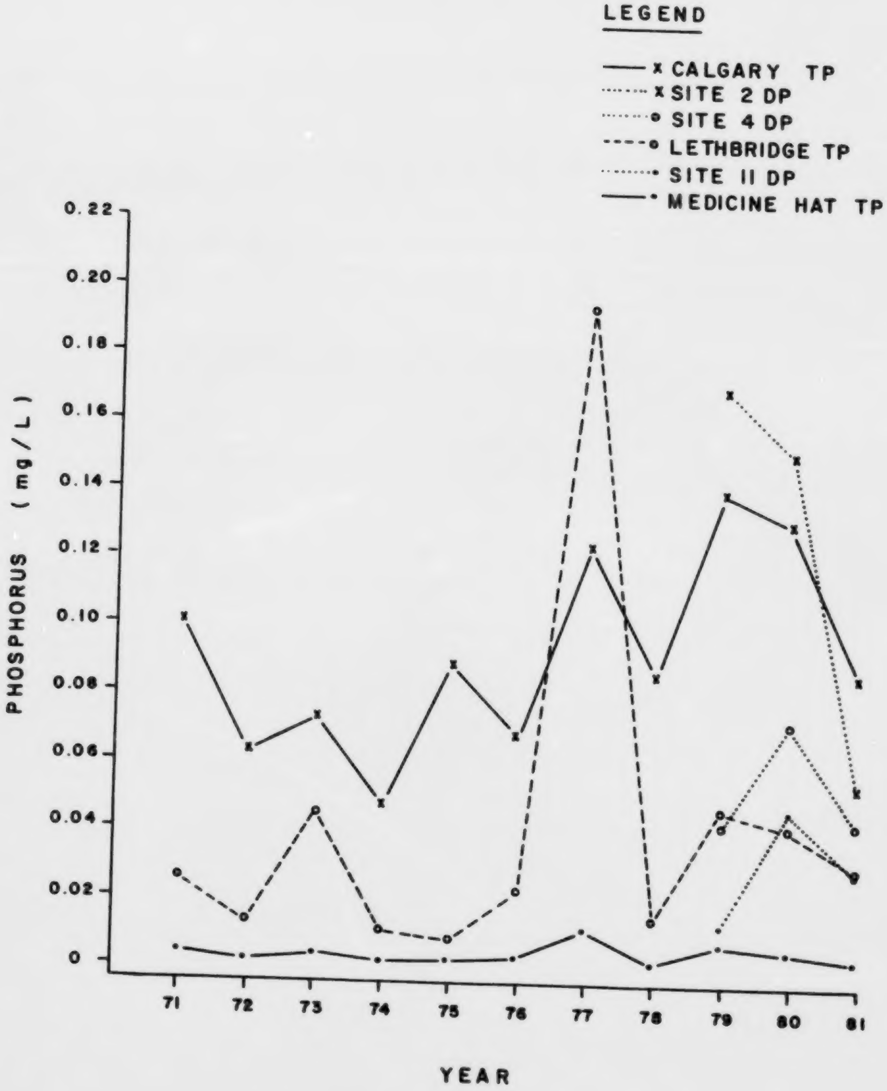

Fig. 34 Comparison of calculated dilution concentrations of total phosphorus from city sewage treatment plants and measured concentrations of dissolved phosphorus in receiving rivers.

concentrations, but the general trend of increasing impact was also shown. In 1978 and 1980 at Calgary, the mean June to September discharges were similar, but higher potential downstream concentrations of phosphorus occurred in 1980 because loading was higher.

Table 15 summarizes the seasonal and annual return flow and tributary loadings and irrigation withdrawals for total and dissolved phosphorus. Overall in the Basin, variation in tributary and return flow loadings was highest in winter and lowest in summer, with loadings varying by as much as 300% in winter. Annually, input variation was highest for dissolved phosphorus loading in the Bow River and total phosphorus loading in the Oldman River. Absolute seasonal loadings were higher in the Bow River in spring, and in the Oldman and South Saskatchewan Rivers in the summer. Irrigation withdrawal loadings from the Bow River were most variable in fall and least variable in summer. Absolute withdrawal loadings were highest in summer.

3.18.3 Reach Loadings

Figures 35 and 36 show average annual and seasonal dissolved phosphorus loadings at each site as the dark base of each 'bar'. The net loading from inputs and withdrawals within the downstream reach is shown as the clear upper portion of each 'bar'. This allows visual comparison of observed dissolved phosphorus loading at each site and

TABLE 15 RETURN FLOW AND TRIBUTARY LOADINGS AND IRRIGATION WITHDRAWALS OF TOTAL AND DISSOLVED PHOSPHORUS ON AN ANNUAL AND SEASONAL BASIS INCLUDING COEFFICIENT OF VARIATION (CV)

Return Flow and Tributary Loading (tonnes)

	Bow River				Oldman River				S. Saskatchewan River				Total			
	1979	1980	1981	CV	1979	1980	1981	CV	1979	1980	1981	CV	1979	1980	1981	CV
Dissolved Phosphorus																
Annual		32.15	21.28	29		3.10	3.72	13		1.84	2.25	14		37.09	27.25	22
Winter		1.46	4.83	76		0	0			0	0			1.46	4.83	76
Spring	12.05	20.09	6.99	51	0.36	0.70	0.82	38	0.27	0.30	0.39	20	12.68	21.09	8.20	47
Summer	5.36	6.08	7.69	19	1.90	2.03	2.34	11	1.23	1.13	1.33	8	8.49	9.24	11.36	15
Fall	1.79	2.91	2.88	48	0.37	0.38	0.65	34	0.26	0.52	0.53	35	2.42	3.81	4.06	26
Total Phosphorus																
Annual		83.48	95.10	9		9.20	13.58	27		3.55	4.02	9		96.23	112.70	11
Winter		3.87	12.79	76		0	0			0	0			3.87	12.79	76
Spring	33.16	54.42	58.96	28	1.46	2.32	3.14	36	0.50	0.51	0.72	22	35.12	57.25	62.82	28
Summer	11.13	14.25	17.53	22	6.36	5.54	8.06	19	2.07	1.86	2.20	8	19.56	21.65	27.79	19
Fall	4.29	7.21	8.73	33	1.44	1.34	2.38	33	0.63	1.17	1.10	30	6.36	9.72	12.21	31

Irrigation Withdrawals (tonnes)

	Dissolved Phosphorus				Total Phosphorus			
	1979	1980	1981	CV	1979	1980	1981	CV
Annual		58.81	74.81	12		78.90	93.30	17
Winter		0	0			0	0	
Spring	9.76	14.09	13.33	19	14.90	19.04	17.88	12
Summer	24.37	25.66	26.92	5	36.94	38.46	37.80	2
Fall	23.78	19.05	34.56	31	9.32	21.40	37.62	62

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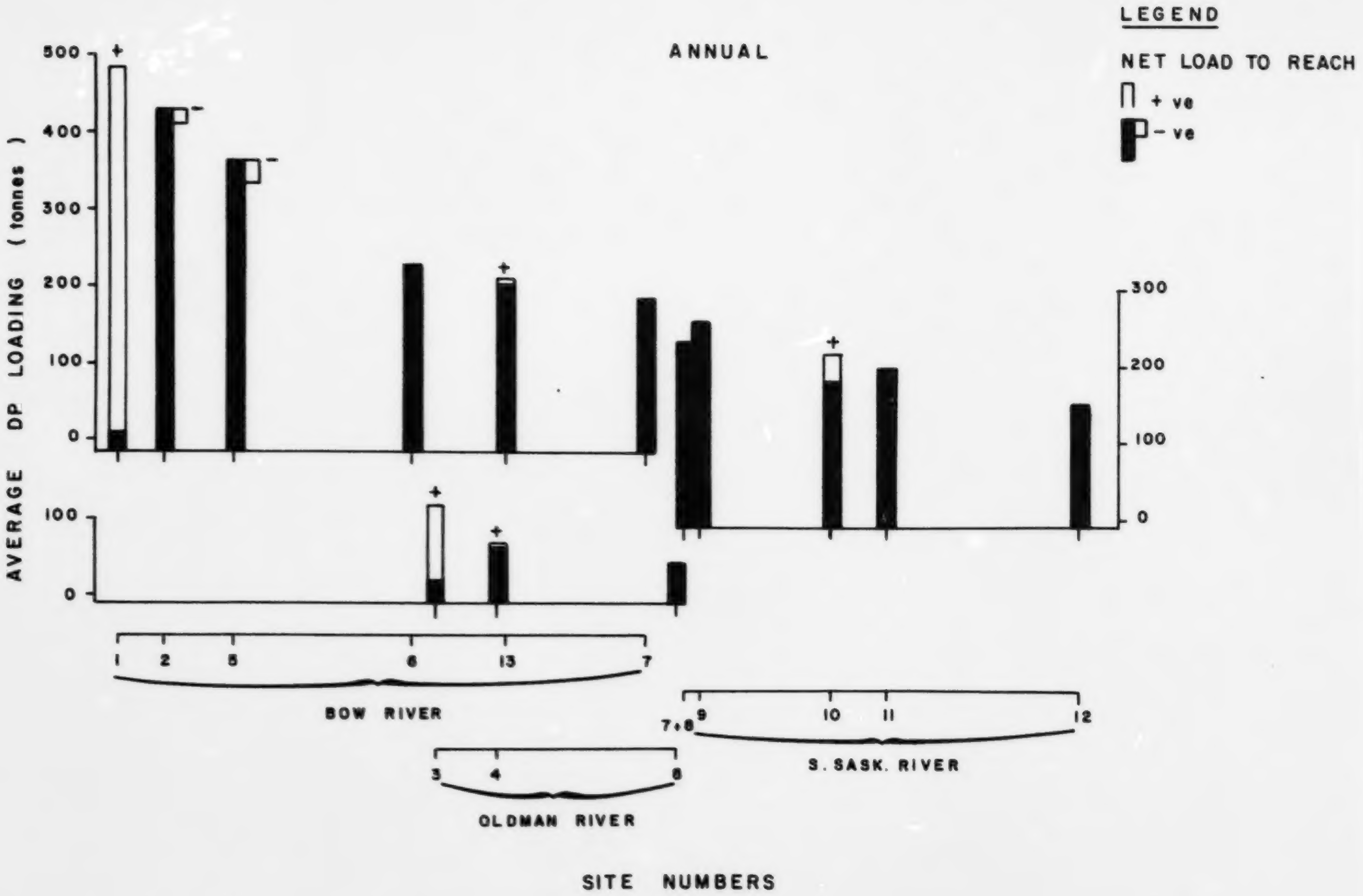

Fig. 35 Comparison of calculated and measured average annual loading of dissolved phosphorus at each site in the study basin.

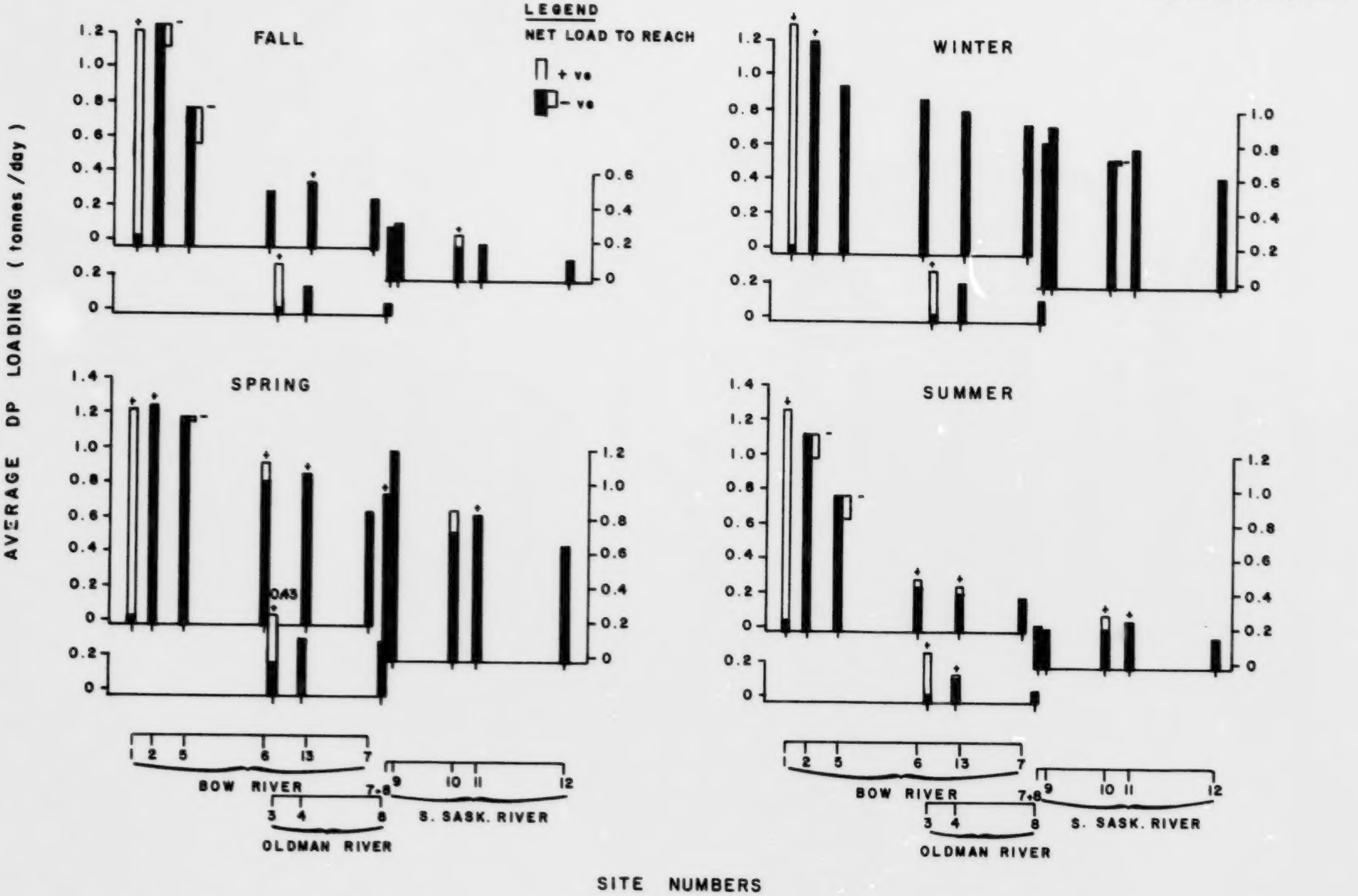

Fig. 36 Comparison of calculated and measured average seasonal loading of dissolved phosphorus at each site in the study basin.

mathematical 'expected' loading. The loading at Sites 7 and 8, at the confluences of the Bow and Oldman Rivers, were combined for ease of comparison with Site 9 in the South Saskatchewan River.

On an annual basis (Figure 35) net input in Reach 1-2 (from Site 1 to Site 2) was most dramatic, followed by net inputs in Reach 3-4 and Reach 10-11. Smaller net loadings were also shown in the reaches in the lower Bow and Oldman and net withdrawals were shown in Reaches 2-5 and 5-6.

Seasonal comparisons (Figure 36) showed that the net inputs in Reaches 1-2, 3-4 and 10-11 remained constant. These were the reaches which included city sewage inputs. In contrast, net inputs at other reaches were more important in summer and within Reach 6-13 in spring than in other seasons. These inputs include irrigation return flows and tributaries. Net withdrawals were more important in summer and fall. Withdrawals occurred at irrigation district headworks. Net loading calculated for each site can be compared to the measured loading at the next site downstream.

The discrepancies between these calculated and measured loadings can be considered as net loading changes within the reach and are given in Table 16. Annually, most reaches registered a net decrease in loading, that is, the calculated loading was less than the measured loading at the end of each reach. The exception was Reach 7-8-9 in both years. The reaches with the greatest net decrease (-2.1 to -1.0 tonnes/km) were 1-2 in 1981, 2-5 in both years, 5-6 in 1980, 3-4 in 1981 and 9-10 in 1981.

TABLE 16:

NET CHANGE IN DISSOLVED PHOSPHORUS LOADING WITHIN EACH RIVER REACH ON AN ANNUAL AND SEASONAL BASIS

	River Reach Loading Change										
Reach	1-2	2-5	5-6	6-13	13-7	3-4	4-8	7-8-9	9-10	10-11	11-12
Reach Length (km)	33	43.5	116	61	90	43	113	36	85	33	124
Annual (tonnes/km)											
1980	-0.63	-1.20	-1.27	-0.55	-0.25	-0.82	-0.20	+0.44	-0.57	-0.32	-0.30
1981	-2.10	-1.03	-0.57	-0.16	-0.28	-1.60	-0.24	+0.93	-1.16	-0.72	-0.48
Seasonal (kg/day/km)											
Spring 1979	-1.96	-9.35	+0.14	-1.88		-3.09	+0.41	+6.32	-2.32	-1.85	-0.92
Summer 1979	+4.90	-10.28	-3.22	-0.53		-3.46	-0.65	+1.17	-1.29	-1.62	-0.27
Fall 1979	+7.26	-12.09	-2.44	-1.33	-0.81	-2.35	-1.00	-0.71	-0.86	-1.14	-0.51
Winter 1980	-1.13	-6.40	-1.00	-1.15	-1.34	-0.33	-0.79	-0.47	-0.89	-1.61	-1.26
Spring 1980	+3.21	+3.22	-5.65	-1.30	-0.08	-2.22	-0.19	+11.54	-6.04	+2.13	-1.68
Summer 1980	-5.97	-3.51	-4.97	-1.43	-0.27	-2.54	-0.87	+0.07	+0.58	-1.82	-0.41
Fall 1980	+1.48	-7.41	-3.98	+2.80	-1.70	-2.28	-0.68	+3.77	-3.07	-2.24	-0.37
Winter 1981	-5.52	-5.98	-0.15	-1.44	-0.15	-2.63	-1.01	+5.31	-3.58	+5.64	-1.24
Spring 1981	-0.28	+1.56	-3.24	-1.14	-1.05	-4.68	-0.53	+4.51	-7.25	-2.36	-1.44
Summer 1981	-11.99	-1.43	-1.95	-0.86	-0.35	-3.71	-1.06	-3.26	+0.54	-1.28	-1.36
Fall 1981	-4.81	-5.45	-0.78	+0.68	-0.52	-3.92	-0.94	-1.44	-0.31	-3.10	-1.46

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Seasonally, in the Bow River the largest net dissolved phosphorus decreases (-12.1 to -9.4 kg/day/km) occurred at Reach 1-2 in summer 1981 and Reach 2-5 in spring, summer and fall 1979. Somewhat lower decreases (-7.4 to -5.0 kg/day/km) were measured at Reach 1-2 in summer 1980 and winter 1981; at Reach 2-5 in fall and winter 1980 and 1981; and at Reach 5-6 in spring and summer 1980. Large net increases (2.8-7.3 kg/day/km) were measured at Reach 1-2 in summer and fall 1979 and spring 1980; at Reach 2-5 in spring 1980; and at Reach 6-13 in fall 1980.

In the Oldman River seasonal net changes were generally smaller than in the Bow. The only net increase (0.4 kg/day/km) occurred at Reach 4-8 in spring 1979. The net decreases in Reach 3-4 were fairly consistent between seasons (-2.3 to -3.9 kg/day/km). The exceptions were winter 1980 (-0.3 kg/day/km) and spring 1981 (-4.7 kg/day/km). This consistency was also shown in Reach 4-8 but at a lower range of values.

In the South Saskatchewan River net increases were highest (3.8 to 11.5 kg/day/km) at Reach 7-8-9 in spring of all years, fall 1980 and winter 1981, and at Reach 10-11 in winter 1981. Largest net decreases (-7.2 to -2.3 kg/day/km) occurred at Reach 7-8-9 in summer 1981; at Reach 9-10 in spring of all years, fall 1980 and winter 1981, and at Reach 10-11 in fall 1980, 1981 and spring 1981.

Table 17 summarizes the relative annual contribution of various phosphorus sources, both total and dissolved phosphorus, directly to the Bow, Oldman and South Saskatchewan Rivers within the three sub-basins. Irrigation withdrawals were not included in the loading

TABLE 17

INVENTORY OF ANNUAL TP AND DP LOADINGS IN TONNES DIRECTLY INTO THE BOW, OLDMAN AND SOUTH SASKATCHEWAN RIVERS WITHIN THE STUDY AREA

		Cities		Irrigation				
Study Basin	U/S	Sewage	S/W	W/D	Return	Trib.	Ind.	Total
TP - 1980	177.5	614.0	30.5	-78.9	38.6	57.3	6.2	924.1
- 1981	792.2	671.0	31.8	-93.3	38.8	73.8	6.2	1613.8
- %	34.2	54.0	2.6	(-7.2)	3.3	5.4	0.5	
DP - 1980	18.8	565.4	5.7	-58.8	16.7	20.4	6.2	633.2
- 1981	45.6	617.8	5.9	-74.8	14.6	12.6	6.2	702.7
- %	4.7	88.6	0.9	(-10.0)	2.4	2.5	0.9	
Bow River								
TP - 1980	21.8	495.8	26.2	-78.9	26.0	57.3	3.4	630.5
- 1981	29.4	511.8	27.0	-93.3	21.2	73.8	3.4	666.6
- %	4.0	77.7	4.1	(-13.2)	3.6	10.1	0.5	
DP - 1980	8.4	456.6	4.9	-58.8	11.8	20.4	3.4	505.5
- 1981	11.4	471.3	5.0	-74.8	8.7	12.6	3.4	512.4
- %	2.0	91.2	1.0	(-13.1)	2.0	3.2	0.7	
Oldman River								
TP - 1980	155.7	89.1	2.5	0	9.1	0	1.8	258.2
- 1981	762.8	118.3	2.8	0	13.6	0	1.8	899.3
- %	72.6	23.8	0.6		2.5		0.4	
DP - 1980	10.4	82.0	0.5	0	3.1	0	1.8	97.8
- 1981	34.2	108.9	0.5	0	3.7	0	1.8	149.1
- %	16.8	78.4	0.4		2.8		1.5	
S. Saskatchewan River								
TP - 1980	539.3	29.1	1.8	0	3.5	0	1.0	574.7
- 1981	1248.4	40.9	2.0	0	4.0	0	1.0	1296.3
- %	95.0	4.2	0.2		0.4		0.2	
DP - 1980	200.1	26.8	0.3	0	1.8	0	1.0	230.0
- 1981	265.6	37.6	0.4	0	2.2	0	1.0	306.8
- %	86.8	12.0	0.1		0.8		0.4	

U/S - upstream, S/W - stormwater, W/D - withdrawal inventory, but irrigation withdrawal and returns flows caused a net reduction in phosphorus loading. In the Bow River sub-basin, large volumes of water are withdrawn at the three irrigation district headworks. Two of these withdrawals are located downstream of Calgary, thus the concentration of phosphorus in the withdrawal water was high. The return flow volumes are lower and in some cases the phosphorus concentrations are lower. Both of these factors contribute to lower phosphorus loading values.

In terms of the entire Basin, 34% of the total phosphorus loading was contributed from waters upstream of Calgary and Lethbridge and 54% from the sewage treatment plants of the three major cities. However, when similar calculations were made with dissolved phosphorus, the upstream contribution dropped to 5% and the sewage treatment plant contribution rose to 89%.

In the Bow River sub-basin, the Calgary sewage treatment plants contributed 78% of the total phosphorus and 91% of the dissolved phosphorus. In the Oldman River sub-basin, the Lethbridge sewage treatment plant contributed 24% of the total phosphorus, while upstream sources contributed 73% of the total phosphorus. Dissolved phosphorus from the sewage treatment plant contributed 78% and upstream sources contributed 17%. Most of the phosphorus in the South Saskatchewan River sub-basin came from upstream waters (the Bow and Oldman Rivers accounted for 95% for total phosphorus and 87% for dissolved phosphorus). The Medicine Hat sewage treatment plant contributed 4% of the total phosphorus and 12% of the dissolved phosphorus to the South Saskatchewan River sub-basin.

In 1981, referring back to calculations of sediment phosphorus, the total phosphorus 'pool' in the sediments along the full length of the Bow River downstream of Calgary (8.3 tonnes) was equivalent to 1.2% of the total phosphorus input to the reach from all sources (Table 17); the corresponding value for the Oldman River downstream of Lethbridge was 0.5%. The total sediment biologically-available phosphorus in each reach was equivalent to 0.4% of the dissolved phosphorus input to the lower Bow River and 1.3% of the total input to the Oldman. Relative to these values, the approximated 1981 flux of phosphorus from the sediments in each river was even less.

3.19 Bonnybrook

The main impetus behind the Bonnybrook study was to investigate further the nutrient concentrations in the reach directly downstream of the Calgary sewage treatment plants. Other variables were measured to help characterize the Bow River within this mixing zone. The Bonnybrook study sites are located by map on Figure 1 and by site and NAQUADAT Code on Table 5.

Temperature increased from May to peak values in August before decreasing more rapidly to low values by the end of October (Figure 37). Along the Bow River, the greatest difference between right and left bank temperatures occurred at Site M2R, which averaged 1.9°C higher than M2L (Figure 38). Temperature increased in a downstream direction by about 3°C to Site M11 and was lower at Sites M12 and M13. The rise in temperature was affected by the order of sampling

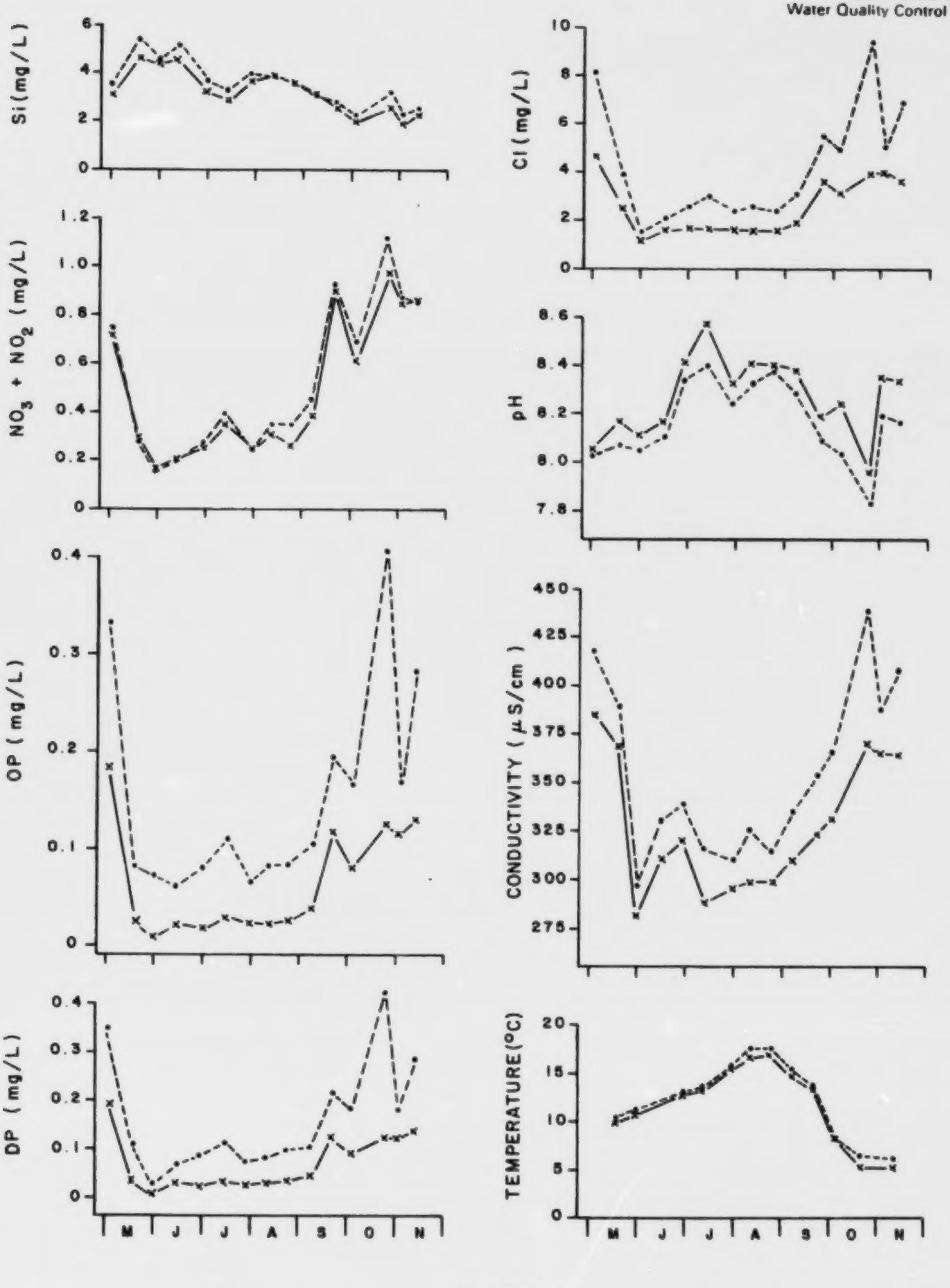

Fig. 37 Comparison between data collected from right (.) and left (x) river banks of the Bow River in the Bonnybrook study using the average of all sites on each date.

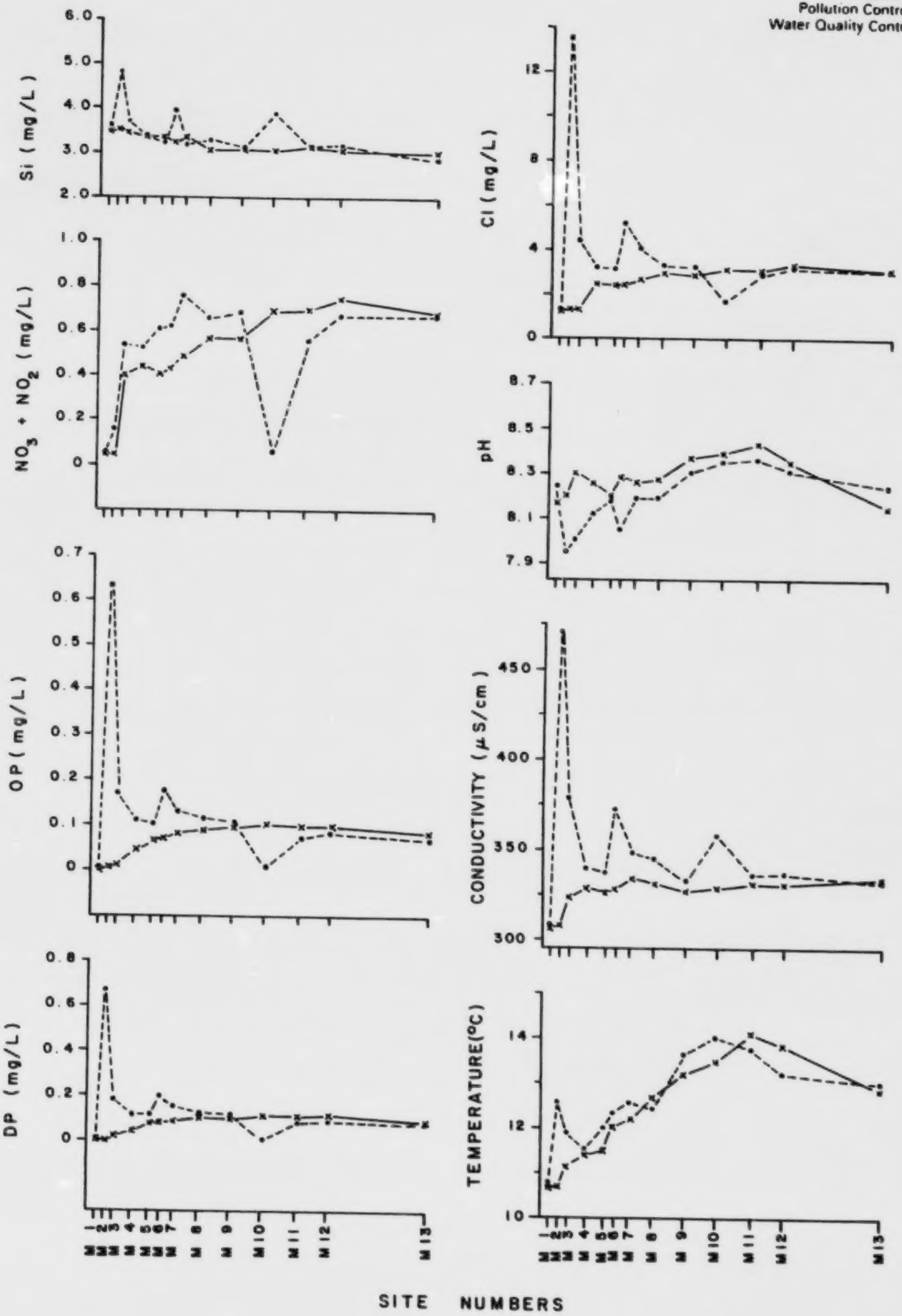

Fig. 38 Comparison between data collected from right (.) and left (x) river banks of the Bow River in the Bonnybrook study using the average of all dates at each site.

from upstream to downstream. The lower temperatures at Sites M12 and M13 were caused by a few missing values at times of high temperature.

Seasonally pH increased from May to July and decreased from September to October with higher values again in November (Figure 37). These trends were more pronounced from Sites M5 to M12. Left bank values averaged higher than right bank values with Sites M2 and M6 showing this most consistently throughout the study. The largest discrepancies between banks, however, was in September and October at Sites M3 and M4.

Longitudinally, left bank pH increased from Site M1L to M3L, decreased to M5L and increased again to M6L, while the opposite was true for the right bank pH, with lowest values at M2R and M6R (Figure 38). Below Site M7, pH followed similar trends on both banks, increasing to Site M11 and decreasing to M13. These trends were shown more strongly from July to November than in May and June. Right and left bank pH values were significantly different (t-test, $p<0.01$) at Sites M2, M3, M4, M11 and M13.

Chloride concentration and conductivity data had a correlation coefficient of 0.87 and both were correlated to phosphorus ($r = 0.97$ and 0.83). Seasonally, average chloride concentrations and conductivity decreased from early to late May and lower values increased from September to November (Figure 37). From June to August, chloride concentrations were relatively constant at about 2 mg/L. During this period conductivity increased through June, then decreased to lower values for July and August. This trend was also evident in chloride concentrations at Sites M2R, M3R and M6R but was masked in the average concentrations.

Chloride at M1, M2L and M3L was relatively constant during the study period, though slightly higher in May and from September to November. However, conductivity at these sites showed trends similar to, but less pronounced than the average trend.

Along the Bow River, chloride and conductivity showed peak values at M2R, M6R and M10R, though the peak at M10R for chloride was reversed (Figure 38). Left bank average concentrations increased from low values at M2L for conductivity and M3L for chloride to higher values which increased slightly through downstream sites. Right and left bank concentrations were similar at Site M9 and at M12. Using paired data for t-test, left and right bank concentrations were significantly different ($p < .01$) from Sites M2 to M10 for chloride and M2 to M9 for conductivity.

Seasonal trends in silica concentrations were similar at all sites at both banks (Figure 37). Concentrations decreased from mid-May to October with fluctuations of lower values in early May and mid-July and higher values in June and August. The downward trend of concentrations through the season was more pronounced at downstream sites.

Average silica trends along the Bow River (Figure 38) showed the influence of the sewage treatment plants and Highwood River at Sites M2R, M6R and M10R with higher average concentrations. Sites M6R and M10R had lower silica concentrations than left bank samples from mid-August through September. A small downstream decrease in average concentration resulted from different seasonal trends along the river. Concentrations were relatively constant in early May, constant to increasing downstream in May and June, and then decreased downstream from July to November. Right and left bank average concentrations were very similar at Sites M5, M9 and M12.

Seasonally, average nitrate/nitrite (NIT) concentrations for both banks followed the same trend: values decreased through May, increased to July, and then remained relatively constant before there was an increase with fluctuations from August to November (Figure 37). The exceptions were Sites M1R, M1L and M2L (Figure 38) which were unaffected by sewage treatment plant effluents and were low through the study period. Site M2R had relatively low nitrate/nitrite concentrations, though concentrations were slightly higher in May and from August to November.

In a downstream direction along the Bow River, average nitrate/nitrite increased from low values at Sites M1 and M2 to higher values at M3. The left bank concentrations increased gradually from Site M5L downstream, while the right bank concentrations increased from Site M4R to M7R, then stayed relatively constant with the exception of M10R which reflected Highwood River water and M11R with slightly lower values. Thus, the right bank had higher concentrations than the left bank from M2 to M9, particularly from M5 to M7 and lower concentrations from M10 to M12. Trends in nitrate/nitrite at each site varied between sampling times. For the left bank an initial peak nitrate/nitrite concentration followed by a decrease occurred at Site M3 in May, October 23 and November 12, and at Site M4 on June 29, July 13 and from mid-August through September; at other sampling times the increase was more gradual and no drop-off was measured.

For the right bank the average concentrations masked distinct seasonal differences in trends along the river. The relatively constant average concentrations at Sites M8R, M9R, M12R and M13R were replaced by generally increasing values in early May and November. The initial increase in concentration to M3R was often less distinctly separated from the general downstream increase, particularly from June to mid-September, when highest relative concentrations were measured at Site M5R. The peak average concentration at Site M7R resulted from peak concentrations at M7R from mid-September to October when absolute concentrations were higher. Comparisons of right and left bank nitrate/nitrite concentrations using paired data showed a significant difference ($p < .01$) at Sites M2 and M5 to M11.

Phosphorus forms (dissolved and dissolved reactive) followed trends similar to the nitrate/nitrite concentrations. In fact, the correlation coefficient (r) for all data was 0.997. Seasonal trends in phosphorus concentration at all sites were similar except where there was low or minimal influence from the sewage treatment plant (Sites M1, M2L and M3L). Longitudinal trends were also similar though absolute concentrations varied.

Figure 37 shows average concentrations of all sites for right and left banks throughout the study period. High concentrations in early May decreased by the end of May. For the left bank, lower levels persisted until early September when concentrations began to increase. Right bank average concentrations were higher than left bank, and concentrations through the summer increased from the low end-May concentration to a peak in mid-July. This was followed by lower concentrations until September when they started increasing again.

Figure 38 shows average phosphorus concentrations at each site for right and left banks down the length of the river. Highest concentrations were measured at Site M2R below Bonnybrook sewage treatment plant and at Site M6R below Fish Creek sewage treatment plant. Otherwise, right bank phosphorus concentration decreased in a downstream direction. Site M10R was below the input from the Highwood River and reflected low levels of phosphorus in the Highwood River water. Left bank concentrations increased gradually in a downstream direct. Left and right bank concentrations were essentially the same at Site M9. Using paired data for t-tests comparing right and left bank concentrations, results were significant ($p < .01$) at Sites M2 to M11.

Despite the significant differences between right and left bank phosphorus concentrations, the average concentrations at Site M1, M5, M9 and M13 were used to calculate summer phosphorus loading. This allowed a more detailed investigation of the net loading changes within the mixing zone of the Bow River below the Calgary sewage treatment plants.

Net loading changes of dissolved phosphorus in the river reaches M1-M5, M5-M9 and M9-M13 were calculated for the summer period (Table 18) to be -1.2, -0.2 and -0.5 tonnes/km respectively. Thus, the greatest net loss of dissolved phosphorus from the river was shown in the reach from above the Bonnybrook sewage treatment plant to above the Fish Creek sewage treatment plant.

TABLE 18 BONNYBROOK STUDY LOADINGS AND NET LOADING CHANGES FOR DP IN SUMMER 1981

Reach	Length (km)	Loading (tonnes)	Loading Change (tonnes/km)
M1-M5	12		-1.23
M1		3.78	
Bonnybrook STP		95.72	
Total		99.50	
M5		84.70	
M5-M9	18		-0.20
M5		84.70	
Fish Creek STP		15.82	
Fish Creek		0.14	
Total		100.66	
M9		97.00	
M9-M13	44		-0.51
M9		97.00	
Highwood River		1.74	
Twelve Mile Coulee		1.12	
Irrigation Diversion		-14.33	
Total		85.53	
M13		63.09	

4.0 DISCUSSION

4.1 Seasonal Variability

Water chemistry is influenced by a number of interrelated factors throughout the Basin which produces a recognizable seasonal variability. These factors are seasonally variable themselves, and include climatological factors, discharge, and biological activity. Groundwater and external inputs from cities, industry, tributaries and irrigation are also important to varying degrees. This variability is reflected in the differences in trends shown within each sub-basin and at each site.

Seasonal trends within the Basin were identified previously on the Oldman and South Saskatchewan Rivers (Davies et al., 1977). Ranges of concentrations differed in some cases but this is not unexpected because of yearly variation.

The solubility of oxygen is primarily determined by temperature, which in turn determines the basic seasonal trend of lower values in summer and higher values in winter. However, there is also a variation shown throughout the day which is dependent on plant photosynthesis and respiration. The size of the diurnal variation shown in the data reflected the relative degree of primary production both among seasons and among sites.

Hart and Exner (1979) reviewed the relationship between diurnal dissolved oxygen and macrophyte growth at sites above and below Calgary. They found that diurnal dissolved oxygen variation below

Calgary was much greater than above Calgary. In fact, the results of the 1979 - 1982 study indicated that the Stiers Ranch site showed the greatest effect of primary producers on dissolved oxygen of any other in the Basin. This effect was highest in summer 1980.

No direct comparison of the magnitude of dissolved oxygen variation between the site immediately below Calgary and that below Lethbridge was possible, since the remote monitor site on the Oldman River is farther downstream at Fincastle (Figure 1). However, Davies et al., (1977) found a diurnal pattern of dissolved oxygen saturation in summer on the Oldman and South Saskatchewan Rivers. Saturation values ranging from about 80% to 120% illustrate the daily rhythm in photosynthesis in the aquatic plants.

Many of the physical variables exhibit basic seasonal trends, with high or low periods over summer or winter and transitional periods through spring and fall. Variables with high winter and low summer values include conductivity, alkalinity, chloride and dissolved inorganic carbon. In fact, the correlation analysis confirmed the positive relationship between these variables overall. The improvement in correlation coefficient when rivers were tested separately reflects basic sub-basin differences in geology, climate, hydrology, land use and instream processes.

The changes in conductivity over a year reflect changes in ionic concentrations. The higher levels measured over winter during periods of base flow reflect the higher salinity of the groundwater within the Basin when undiluted by rainfall and snowmelt.

Chloride, a conservative ion, is a component of the conductivity measurement. Concentrations found in base flow are affected by influences external to the river and they tend to increase in a downstream direction. The influence of chloride input from sewage treatment plants was most evident at Site 2, but there was additional chloride input from irrigation return flows. The influence of discharge on this variable is also shown by the rapid drop-off of chloride concentration during high flow in spring.

The very high levels of chloride in December in the Bow River may have been caused by the freeze-out of salts during ice formation and higher proportional contribution of groundwater to base flow. The increase in chloride in the Bow River through summer and fall was moderated in the South Saskatchewan by the influence of the Oldman River, where chloride concentration decreased from August to November. This decrease may result from the reduction in irrigation return flows.

Alkalinity, as a measure of the buffering capacity of the river water, is affected by the changes in carbon dioxide utilization and release over a season. The changes were related to the biological activity of primary producers, and were reflected also by the trends of pH changes. In summer, pH was high and alkalinity was low when photosynthetic activities were greatest, and in winter pH was low and alkalinity was high when decompositional activities predominated.

Bow River results covered the widest range of pH values, and indicated the extremes of biological activity. A second trend of strong diurnal pH fluctuations measured at Site 2 below Calgary in the summer indicated the significant local effect of a large plant population.

Turbidity and non-filterable residue give a measure of the particulate matter or suspended sediments which predominate during high flow periods in spring. During 1980 the volcanic ash from Mount St. Helens affected this measurement as well, both directly and when washed into the river after a rain. Other particulate variables of particulate organic carbon, particulate nitrogen and total phosphorus reflected the discharge levels in the rivers. The significant correlations amongst these variables and with discharge confirmed this relationship.

Higher concentrations of particulate variables were measured in the fall as a result of the addition of plant material during senescence. The variation among years was largely determined by climatic conditions, such as rainfall, snowmelt and temperature, which affected discharge. The Bow River, with a more regulated discharge, showed lower extremes of particulate variables than the Oldman or South Saskatchewan Rivers.

The concentration of reactive silica and the growth cycle of diatoms are inter-related. Peak values in diatom populations often match low values in silica concentrations. Low silica concentrations occurred in late summer/fall and briefly in early spring, and these should correspond to large diatom populations. Diatom populations in winter and during peak discharge would be expected to be low. These relationships are addressed in Part II (The Primary Producers; Charlton et al., 1986).

Carbon is an important nutrient for plant growth. Although particulate organic carbon showed seasonal trends related to discharge, the importance of the inputs from Calgary sewage treatment plants were apparent in the results for the Bow River at Site 2 below Calgary which showed little seasonal pattern. The seasonal pattern of dissolved inorganic carbon concentrations, like alkalinity, was affected by carbon dioxide utilization and release cycles of primary producers.

The changes in phosphorus and nitrogen concentrations over a year reflected changes in plant life cycles. Nutrients are utilized for growth and released upon senescence. These nutrient concentrations are correlated more strongly in the Bow than the Oldman River. At upstream sites on the Bow (Site 1) and Oldman (Site 3) Rivers, concentrations were generally low and seasonal changes were minimal. At Site 2 and 4, below Calgary and Lethbridge, the reduction of nutrients from high winter values caused by plant uptake was reinforced by the dilution effect of high discharge. In fact, the impact of plant utilization became more obvious at downstream Bow River sites as reduced nutrient concentrations were prolonged through the summer. By Site 13, low levels of phosphorus and nitrogen were maintained through the summer, a pattern which was shown also in the South Saskatchewan River. The contribution of phosphorus from the Medicine Hat sewage effluent appeared to have negligible additive effect to the concentration carried by the river, and was probably used very rapidly by plants within the reach below its input.

In the Oldman River, extreme peak values of total phosphorus occurred when large amounts of particulates were carried by the river during high discharge. Site 4 showed the effects of a major input of phosphorus from the Lethbridge sewage treatment plant, but phosphorus seemed to be less controlled by plant utilization than Site 2 in the Bow River. In 1980 a second distinct peak concentration of phosphorus in August indicated that less phosphorus was being taken up at that time, though the trend was reversed and utilization increased until October. The uniformly low concentrations of dissolved phosphorus from May to October at Site 8 indicated that plant utilization depleted the phosphorus within the reach of river from the Lethbridge sewage treatment plant input to Site 8.

Dissolved nitrogen patterns in the Oldman River were distinctly different from phosphorus patterns from May to October, 1980. At Site 4 when phosphorus increased from low values in May/June to August and then decreased to October, nitrate/nitrite was at or near detection levels. Under this circumstance, plant growth would be limited by nitrogen. At Site 8 the summer nitrogen was consistently low from July, as was the phosphorus.

Results from two other studies in Canada are discussed briefly to indicate comparability of this study. In another large river study, seasonal variation in nitrogen forms in the Red River, Manitoba (Chacko et al., 1981), was similar to that found in the South Saskatchewan River Basin Study with respect to lower summer values. The Red River study, however, put less emphasis on winter sampling, and highest values for nitrate were measured in late April rather than

December/January. All phosphorus forms showed a similar trend within the Red River data with higher values in June/July. This finding was in contrast to the results reported in our study. Our results showed that the peak concentrations were measured over winter, and that there was a second sharp peak value in spring for total phosphorus. Fluctuations in concentrations were generally less for all nitrogen and phosphorus forms in the Red River than in the South Saskatchewan Basin Study rivers.

Seasonal studies of nitrate plus nitrite on the Okanagan River, British Columbia (Kleiber, Whitfield and Erlebach, 1978) showed highest values in December and lowest in March, which was much more similar to the South Saskatchewan River Basin Study results. For total phosphorus, highest concentrations were measured in March on the Okanagan River and lowest concentrations were measured in September. These results were more similar to results for lower Oldman and South Saskatchewan River sites than Bow River sites. The absolute concentrations were much lower in the Okanagan River than in any of the Bow, Oldman and South Saskatchewan Rivers.

4.2 Historical Nutrient Data

The comparison of historical and study nutrient data gave some indication of an increasing supply of nutrients. However, evaluation was complicated for several reasons. First, the database for the historical means was small, therefore, values could be strongly influenced by one extreme value. To use a current example (which will become part of historical record), during the eruption of Mount St. Helen's, the one very high value for total phosphorus would completely dominate any calculation of an average value.

Second, the seasonal distribution of samples used to calculate annual mean could be very different between the two sets of data. Thus, the seasonal variation in concentration would bias the average concentration.

Finally, historical data were accepted at face value since verification was not feasible. Until relatively recently, total phosphorus was expressed chemically as mg PO_4/L rather than mg P/L (1 mg PO_4/L = 0.326 mg P/L). Often the distinction was not made clear in the results and could have led to entry of historical data onto NAQUADAT as mg P/L when, in fact, the values were mg PO_4/L. Thus, some historical data could be interpreted as being about three times higher than were in fact measured.

Despite the difficulty of comparison, several factors indicated that the impact of Calgary sewage on downstream nutrient concentrations has increased. Firstly, although the historical total phosphorus data were higher than study values, the opposite was true for dissolved phosphorus at downstream river sites. The dissolved phosphorus data were less likely to have the first and third uncertainty factors, detailed above, and dissolved phosphorus was the main phosphorus form input to the river from the sewage treatment plant.

Secondly, in winter the study data for both dissolved phosphorus and nitrogen were higher than the historical data. Winter data provide a more comparable indication of 'diluted inputs' since flows were relatively similar between years and reduced biological activity allowed transport of nutrients to downstream sites.

4.3 Biologically-Available Phosphorus

The bioavailability of particulate phosphorus has been evaluated for various surface water types in systems draining to the Great Lakes and in parkland streams of central Alberta (Table 19). Generally, the range of values observed in the South Saskatchewan River system appeared comparable to those derived elsewhere.

Although data were limited, Sephadex-gel filtration analysis indicated that the chemical dissolved reactive phosphorus test did provide a close approximation of orthophosphate for the basin in March and July. The deviation between forms measured to be significant elsewhere (Rigler, 1966; Downes & Paerl, 1978; Peters, 1978; Stainton, 1980) is not appreciable in these rivers. Dissolved reactive phosphorus, however, did not provide the best estimate of dissolved biologically-available phosphorus as measured by algal assay techniques. Dissolved inorganic phosphorus was the best predictor of dissolved biologically available phosphorus for all three rivers, and indicated that in addition to orthophosphate, the complex inorganic compounds in the system were readily available for biological uptake. The overestimation of dissolved biologically-available phosphorus by dissolved phosphorus implied that dissolved organic phosphorus was not available under these test conditions.

The greatest deviation between dissolved reactive phosphorus and dissolved inorganic phosphorus (and, therefore, dissolved biologically-available phosphorus if one assumes the two are equal) occurred in the Oldman when compared to the Bow River. The reason for

TABLE 19 LITERATURE REVIEW OF PERCENT AVAILABILITY OF SUSPENDED PARTICULATE PHOSPHORUS IN SURFACE WATERS

RIVER	LOCATION	% AVAILABILITY	TECHNIQUE	AUTHORS
Genesee	New York	19%	NaOH-P	Armstrong et al, 1979
Grand	Michigan	35%	NaOH-P	Armstrong et al, 1979
Nemadji	Wisconsin	14%	NaOH-P	Armstrong et al, 1979
Maumee	Ohio	35%	NaOH-P	Armstrong et al, 1979
Lake Ontario and Erie Tributaries	Ontario	8-50%	NaOH-P	Williams et al, 1980
Black Creek	Indiana	20%	Algal Assay	Dorich et al, 1980
Genesee	New York	38%	Algal Assay	Cowen et al, 1978
Niagara	New York	45%	Algal Assay	Cowen et al, 1978
Oswego	New York	38%	Algal Assay	Cowen et al, 1978
Black	New York	36%	Algal Assay	Cowen et al, 1978
Urban Runoff	Wisconsin	30%	Algal Assay	Cowen & Lee, 1976
Wabamun Streams	Alberta	49-70%	Algal Assay	Water Quality Control Branch

this greater relative abundance of complex inorganic compounds in the Oldman River is not fully understood. It may be simply a function of the overriding importance of the sewage treatment plant discharges on Bow River phosphorus chemistry, bearing in mind that dissolved reactive phosphorus accounted for 90% of sewage discharge phosphorus. Relative dissolved phosphorus availability and forms in the South Saskatchewan River appeared to be controlled by conditions in its two source rivers, the Bow and Oldman Rivers.

Seasonally, dissolved inorganic phosphorus tended to form a larger proportion of dissolved phosphorus in winter months and a lower percentage during summer and fall intervals. Thus, organic phosphorus was of greater significance to the dissolved phosphorus fraction during the open water season. Likely sources of this dissolved organic phosphorus were surface runoff and instream biological activity, both of which were maximal during summer and fall. Low dissolved organic phosphorus content in the system during winter also confirmed that the sewage treatment discharges were not a significant source of such material.

Although our results indicated that dissolved organic phosphorus was not immediately bioavailable, work elsewhere has shown that a certain proportion is ultimately degraded and made available because of bacteriological processing, ultraviolet irradiation and/or alkaline phosphotase activity (Franko & Heath, 1979). Peters (1978), using radioisotope techniques, concluded that 50% or more of the dissolved organic phosphorus in agricultural streams draining to Lake Memphremagog was actually bioavailable. Other investigators have concluded that although certain forms of organic phosphorus are degradable, refractory organic compounds, entirely resistant to mineralization, do exist in aquatic systems (Lean, 1973; Lee et al., 1980). The observed non-availability of dissolved organic phosphorus in the South Saskatchewan River Basin Study may have been partially a function of the algal assay technique employed. Sample pretreatment by membrane filtration removed the natural bacteriological community from the test water, and thereby excluded any microbial processing of organic material during the test interval.

In light of the uncertainty surrounding dissolved organic phosphorus availability, Lee et al. (1980) recommend that the dissolved organic fraction be considered available for phosphorus management purposes, particularly when this fraction was of minimal overall significance relative to dissolved inorganic phosphorus. In the case of the South Saskatchewan Basin, this recommendation was confirmed since dissolved inorganic phosphorus comprised 75 to 85% of the dissolved phosphorus in the system.

The relationship between particulate phosphorus availability and dissolved biologically-available phosphorus implied that inorganic phosphate adsorption to suspended particulates is the major determining variable. Particulate phosphorus, where availability is low upstream of major dissolved phosphorus inputs, entered the system from erosional sources and was largely of the apatite form (Ongley and Blachford, 1982) which has been shown to be biologically inert (Williams et al, 1976, 1980; Millard et al., 1979). When brought in contact with dissolved phosphates, that is, downstream of Calgary and Lethbridge, phosphate was adsorbed to the particulate matter.

Desorption can occur as a result of chemical and biological mechanisms: simple chemical desorption results if the equilibrium is shifted by lowering the dissolved inorganic phosphorus concentrations (Stumm & Morgan, 1970); further desorption is possible if a high biological demand for phosphorus is present in the system. A phosphorus limited algal community functions as a sink for phosphorus which continually forces transfer of phosphates from the particulate to the dissolved phase (McColl, 1975; Golterman, 1977, Huettl et al., 1979).

The high proportion of dissolved phosphorus in sewage discharges (≃90%) and the high contribution of available dissolved reactive phosphorus to the dissolved component led to the conclusion that sewage effluent phosphorus is highly bioavailable. Young et al., (1982) undertook a detailed study of phosphorus availability in numerous sewage treatment plants and found that, on average, 82% of dissolved phosphorus and 55% of particulate phosphorus in sewage effluent was readily available for plant growth.

During the biologically-active summer and fall periods in the South Saskatchewan River system, dissolved biologically-available phosphorus formed 80 to 90% of the total biologically-available phosphorus in the high phosphorus content reaches downstream of Calgary and Lethbridge. This was also where nuisance aquatic weed growth was most acute. In the lower reaches of the Bow and Oldman Rivers, and throughout the South Saskatchewan River, particulate biologically-available phosphorus could comprise up to 40% of total biologically-available phosphorus. However, these high proportions occurred at low overall phosphorus levels, when nuisance plant growth was not significant. This suggested that dissolved biologically-available phosphorus, rather than particulate biologically available phosphorus, and consequently dissolved phosphorus, was more significant in stimulating plant growth to nuisance levels. Particulate biologically-available phosphorus may have been utilized by the biological community, but it was likely of secondary importance.

4.4 Nutrient Limitation

In the South Saskatchewan River Basin study, climatological and physical factors were more important than nutrient control of primary production during winter, as they were to varying degrees in spring and fall. Summer is the period when nutrient limitation of primary producers is most important. At Site 1 and 3 above Calgary and Lethbridge, respectively, the high ratios of dissolved nitrogen to dissolved phosphorus, low absolute nutrient concentrations and consistency between algal growth potential and nitrogen-spiked algal growth potential data, indicated that phosphorus was probably the nutrient which controlled primary production throughout the year. Similar conditions in the South Saskatchewan River from July to September at Site 9, and from May to October at the three downstream sites., suggested a similar conclusion.

The data from the Bow and Oldman Rivers below the cities were somewhat more complex and they changed with distance downstream from the cities. At Sites 2 to 6 below Calgary on the Bow River, ratios of dissolved nitrogen to dissolved phosphorus were relatively low, but absolute concentrations were high and algal growth potential data indicated that there was no nutrient limitation. The one exception occurred in May/June, although any growth at this time of peak discharge would be limited by physical conditions of light, temperature and abrasion. Further downstream, at Sites 13 and 7, high ratios in summer and fall, low absolute concentrations in summer but not fall, and agreement between algal growth potential and nitrogen-spiked algal growth potential data suggested that phosphorus was the controlling nutrient in summer in the lower Bow River.

The data from Site 4 below Lethbridge were quite different from those from Site 2 below Calgary. The two sets of algal growth potential data were only similar briefly in May and October, but dissolved nitrogen to dissolved phosphorus ratios were low in all seasons except spring, when discharge related factors predominated. Phosphorus and nitrogen concentrations were low during summer, but the other data indicated that it was not phosphorus, but nitrogen, which was the element controlling the primary production at Site 4 in summer.

At Site 8, high nutrient ratios, low concentrations in summer and fall, and consistency between the two sets of algal growth potential data from May to November suggested that phosphorus was the controlling nutrient in the Oldman River at its confluence with the Bow River.

4.5 Sediment Phosphorus

Sediment phosphorus is a complex mixture of organic and inorganic forms (Armstrong et al., 1971; Stumm and Leckie, 1971; Syers et al., 1973). Apatite phosphorus is ortho-phosphate incorporated into the crystal lattice of apatite grains (Williams et al., 1976) and is the eroded form of sedimentary rock. The predominance of apatite phosphorus in sediments of South Saskatchewan Basin Rivers is understandable considering their mountain origin and the sedimentary nature of prairie soils. Ongley and Blachford (1982) found proportions of apatite phosphorus in suspended sediments of the Bow and Oldman Rivers similar to those measured in this study. The remaining inorganic phosphorus forms quantified by the non-apatite inorganic phosphorus test included iron and calcium phosphates and phosphate ions adsorbed to clays and organic compounds. Sedimentary organic phosphorus consisted of compounds of various complexity derived from decaying aquatic biota and input via surface runoff.

Laboratory studies (Golterman, 1977; McColl, 1975; Sagher et al., 1975) have shown some portion of aerobic sedimentary phosphorus to be available for algal growth. Of the various forms, apatite is usually considered unavailable while non-apatite inorganic phosphorus is considered the most available (Sagher et al., 1975; Williams et al., 1976, 1980). The very high correlation between sediment biologically-available phosphorus and non-apatite inorganic phosphorus for South Saskatchewan River Basin rivers substantiated this observation. However, the general underestimation of sediment biologically-available phosphorus by non-apatite inorganic phosphorus may indicate that a portion of the sediment organic phosphorus pool was also available under assay test conditions. Although the sediments were freeze-dried prior to assay testing, they were not sterilized by autoclaving. Consequently, bacteriological activity was evident in the test flasks and subsequent biological breakdown of organic compounds could have occurred. There is no reason to believe that a certain proportion of the sediment organic phosphorus would not be made available under natural river conditions as well. However, complete utilization of sediment organic phosphorus was unlikely. Various studies have shown a certain proportion of organic compounds in aquatic systems to be resistant to all breakdown mechanisms (Lee et al., 1980).

The apparent buildup in fall and winter of non-apatite inorganic phosphorus and sediment organic phosphorus in river sediments downstream of Calgary, and to a lesser extent Lethbridge, was likely related to sewage treatment plant phosphorus inputs and the extensive summer aquatic plant populations which developed in these reaches. The high inorganic phosphorus levels during fall and winter in river water observed in these reaches would favour adsorption of phosphates to sedimentary material (Stumm and Morgan, 1970; Green et al., 1978). This would be measured as non-apatite inorganic phosphorus. The cobble nature of the substrate would favour this mechanism by ensuring river water contact with the imbedded fine particulate sedimentary material. Organic phosphorus accumulation during fall and winter can be attributed to death and decay of the macrophyte and benthic algal communities.

The summer decline in sediment non-apatite inorganic phosphorus and sediment organic phosphorus concentrations was probably caused by a combination of three factors: 1) reduced spring and summer ambient river phosphorus concentrations that favoured desorption of phosphate ions from the sediment phase in order to maintain sorption kinetic equilibria (the strong correlation between dissolved inorganic phosphorus and non-apatite inorganic phosphorus supports this hypothesis); 2) elevated spring flows that resulted in resuspension and transport of fine particulate sedimentary material accumulated during the low flow period during fall and winter. Deposition of upstream sediments, low in non-apatite inorganic phosphorus and sediment organic phosphorus, in turn, occurred as discharge levels dropped in late June or early July; 3) non-apatite inorganic phosphorus and sediment organic phosphorus was depleted by biological uptake during the summer growth period.

The latter mechanisms was likely not significant in the reaches where dissolved phosphorus levels remained high all summer. However, in the downstream reaches where dissolved inorganic phosphorus was depleted, greater non-apatite inorganic phosphorus dissolution than that caused by normal solubility product equilibria could result from a high biological demand for phosphorus (Huettl et al., 1979).

In spite of the latter mechanism, the low overall bioavailability of sediment phosphorus in the basin (12 to 35%), and small quantity relative to soluble phosphorus transported in the water column, it was concluded that sediment phosphorus was not currently a major phosphorus source that contributed to aquatic plant growth.

4.6 Phosphorus Loading

The phosphorus loading concept was originally developed in relation to lakes and the biological response to inputs of phosphorus (Rawson, 1939; Edmondson, 1961; Vollenweider, 1976). The concept was also used in river basin studies to determine relative contributions of different sources of phosphorus (Peters, 1973; Alberta Environment, 1979) and to study the retention and transport of phosphorus through a river system (Aiba and Ohtake, 1977; Meyer and Likens, 1979; Rigler, 1979; Hill, 1982). Further developments in the loading concept included consideration of the bioavailability of the phosphorus which should be used in loading calculations (Schaffner and Oglesby, 1978; Sonzogni et al., 1982).

Calculations of phosphorus loading in the basin using total and dissolved phosphorus gave significantly different results. The source inventory for the Basin indicated that 34% of the total phosphorus came from upstream sources, compared to the sewage treatment plants (54%). However, when dissolved phosphorus is considered, the importance of the sewage treatment plant inputs rose to 89%. The shift from upstream sources to sewage treatment plant sources was shown most dramatically in the Oldman River where upstream sources dropped from 73% of total phosphorus to 17% of dissolved phosphorus and sewage treatment plant changed from 24% to 78%, respectively.

The change in emphasis from upstream sources was important, particularly when the two phosphorus forms are considered. Total phosphorus included phosphorus contained in particles - particulate phosphorus, while the dissolved phosphorus was more readily available for use by the biological community.

When the dissolved phosphorus source inventory was separated into sub-basins, Calgary, Lethbridge and Medicine Hat sewage treatment plants contributed 91%, 78% and 12%, respectively, of the loadings. The highest relative return flow and industrial contribution was in the Oldman River at 3% and 2%, respectively. Considering the whole Basin, of the 89% source attributed to the sewage treatment plants, 70% was from Calgary, 14% was from Lethbridge and 5% was from Medicine Hat.

The impact of Calgary's sewage outflow on the Bow River in terms of nutrient input, though reduced in the early 1970s, has been increasing rapidly along with its population since 1974. During this same period, mean annual discharge in the Bow River was below average 7 out of 10 years. The low discharge was shown dramatically in the five consecutive years of very low maximum daily discharge from 1975 to 1979.

The coupling of rapidly increasing nutrient loading from the Calgary sewage treatment plant with consecutive years of extreme low flow hydrological conditions produced ideal conditions in summer for luxuriant growth of primary producers in the Bow River.

Phosphorus in the rivers below sewage treatment plants was attenuated by macrophyte and algal uptake and sediment adsorption. Our present studies have shown this, and so have others (Aiba and Ohtake, 1977; Anders, 1977; Brown et al., 1982). We found that the most dramatic reductions in phosphorus loading by plant uptake occurred within the reaches from below Calgary to Bassano (Site 6) and below Lethbridge. These reductions were most apparent in summer and fall, and were the most indicative of maximum plant uptake of nutrients within the entire basin. Throughout the study period, the general trend was for net uptake of nutrients in the basin. Using the dissolved phosphorus loading inventory and the measured loading at Site 12, there was a net uptake in the basin of 75% of the dissolved phosphorus through 1980 and 1981.

The net uptake of dissolved phosphorus in the basin would be balanced somewhat by the nutrient loss from the basin in drifting of senescent macrophytes. This was not quantified. However, phosphorus retained in the basin would also be incorporated in secondary producers and more permanent primary producers.

5.0 SUMMARY

The purposes of the South Saskatchewan River Basin Study were to 1) examine the present state of the rivers, 2) determine the present response of the river to nutrients, and 3) develop phosphorus budgets for the basin. This report addresses the first objective, with respect to water chemistry, and the third objective.

Water chemistry data were collected routinely from May, 1979 to April, 1982 at thirteen sites throughout the South Saskatchewan River Basin: six sites were on the Bow River; three sites were on the Oldman River; and four sites were on the South Saskatchewan River. Additional data from remote monitors and from Water Quality Branch, Environment Canada, and Water Survey of Canada were used, as was information collected by the cities of Calgary, Lethbridge and Medicine Hat. Data from discharge studies of irrigation water, stormwater and industrial effluent were also incorporated.

Three studies were carried out to investigate sampling technique and additional studies were made of biologically-available phosphorus and sediment phosphorus. A closer investigation of the nutrient chemistry of the Bow River between Calgary and Carseland was undertaken in 1981.

Water chemistry was affected by the interrelated factors of climate, discharge and biological activity. Temperature related oxygen solubility showed basic trend of lower summer values and higher winter values. However, diurnal fluctuations of dissolved oxygen were dependent on plant photosynthesis and respiration. The size of these fluctuations was greatest at Site 2 (below Calgary), and indicated the pronounced effect of primary producers at this site, particularly in the summer of 1980.

Water chemistry in the South Saskatchewan River often showed trends which were intermediate, or a combination of trends in the Bow and Oldman Rivers.

Correlated variables with high winter and low summer values included conductivity, alkalinity, chloride and dissolved inorganic carbon. Trends in pH values were opposite. Chloride and conductivity values reflected the freeze out of salts during ice formation, the higher salinity of groundwater base flow in winter, and the effects of inputs from the sewage treatment plants and irrigation return flows. Mean annual values of chloride and conductivity in the Bow, Oldman and South Saskatchewan Rivers were 4.4 mg/L and 366 μS/cm, 3.5 mg/L and 418 μS/cm and 5.2 mg/L and 413 μS/cm, respectively.

Alkalinity, pH and dissolved inorganic carbon were affected by the changes in carbon dioxide utilization and release by primary producers. During summer photosynthetic activities predominate, and during winter decompositional activities predominate. Average alkalinity was 127 mg $CaCO_3$/L in the South Saskatchewan River, 141 mg/L in the Oldman River and 123 mg/L in the Bow River.

Measures of particulate matter (turbidity and non-filterable residue) and related variables (particulate organic carbon, particulate nitrogen and total phosphorus) correlated with discharge and hence were high in spring. The more regulated Bow River showed lower turbidity values (averaging 7 JTU) than the Oldman River (averaging 56 JTU). The particulate nutrients were also high in the fall as a result of the addition of plant material during senescence.

The concentration of reactive silica was inversely related to the growth cycle of diatoms. Peak concentrations of silica (4-6 mg/L) were measured in mid-winter and in late spring/early summer and low values (less than 1 mg/L) were measured in late summer/fall and briefly in early spring.

Carbon was an important nutrient for plant growth. Average concentrations in the Bow, Oldman and South Saskatchewan Rivers, respectively, were: for particulate organic carbon 0.9, 1.3 and 1.4 mg/L; for dissolved organic carbon, 2, 3 and 3 mg/L; and for dissolved inorganic carbon 28.8, 32.5 and 29.2 mg/L.

Highest ammonia concentrations were measured below Calgary during winter and early spring (maximum of 2.9 mg/L).

Nitrogen and phosphorus concentrations throughout the Basin generally followed an annual pattern of high values in winter and low values in summer. The changes in concentrations over a year reflected changes in plant utilization for growth and release upon senescence.

Nutrient concentrations at sites upstream of Calgary and Lethbridge on the Bow and Oldman Rivers were generally low (dissolved phosphorus = 0.003 mg/L). Values increased below the cities, most dramatically at Site 2 below Calgary, which recorded the highest values (dissolved phosphorus = 0.43 mg/L) in December, 1980.

Two trends in changing concentration of nutrients were shown at the Bow River sites below Calgary: 1) concentrations decreased in a downstream direction; 2) the duration of low summer concentrations lengthened at each downstream site until low values were recorded at its confluence with the Oldman River from July to the end of September for dissolved nitrogen forms, and from May to October for dissolved phosphorus forms.

Changes in phosphorus loading within different reaches of the Bow River reflected the relative uptake of phosphorus by plants. The attenuation of phosphorus in the river was most dramatic from Calgary to Bassano during summer and fall.

Studies of water chemistry on both sides of the Bow River from the Calgary sewage treatment plant to Carseland (Bonnybrook Study) showed that phosphorus concentrations on the right bank were elevated below Bonnybrook sewage treatment plant and Fish Creek sewage treatment plant and then decreased at downstream sites. In contrast, on the left bank, concentrations increased gradually from low values at upstream sites until concentrations showed lateral mixing, and were comparable to right bank concentrations. This occurred at the approximate location of the downstream Calgary Site 2 of the routine sampling program.

Interpretation of historical river nutrient data must be made cautiously, but there is some evidence to suggest that the impact of Calgary sewage in downstream dissolved phosphorus concentrations has increased in recent years to the level found prior to phosphorus removal.

The nutrient input from Calgary sewage systems to the Bow River has increased rapidly since 1974. Increased loading in conjunction with low flow conditions produced ideal conditions in summer for luxuriant growth of primary producers in the Bow River.

The Bow River showed a smaller range of fluctuations in mean annual discharge than the Oldman River. During the 1970's, the long-term average annual discharge was exceeded only in 1972, 1974 and 1976. From 1975 to 1979 the very low maximum discharge values were equalled only in three previous years since readings were recorded.

Phosphorus ratio analysis showed that the relative proportion of inorganic to organic phosphorus was generally higher in the Bow River than the Oldman or South Saskatchewan Rivers, and high in winter and low in summer. Dissolved phosphorus, as a proportion of total phosphorus, was highest in the Bow River, and high in winter and low in spring.

Dissolved inorganic phosphorus concentrations were most comparable to dissolved biologically-available phosphorus. However, the long-term availability of dissolved organic phosphorus may not be adequately measured by the algal assay technique. Since dissolved organic phosphorus has been identified as available by other researchers, dissolved phosphorus, which includes both inorganic and organic forms, gave a good estimate of dissolved biologically-available phosphorus.

Phosphorus from sewage treatment plants was mostly (90%) in the dissolved form and hence available. On an annual basis total phosphorus in the Bow River downstream of Calgary was 80% to 90% available, while total phosphorus in the Oldman River was only 51% to 75% available.

Information gathered by Sephadex-gel filtration techniques indicated that in March dissolved reactive phosphorus measurements did not include high molecular weight phosphorus compounds. Therefore, dissolved reactive phosphorus measurements did provide a good estimate of orthophosphate, which is biologically available.

The availability of particulate phosphorus was determined by inorganic phosphate adsorption to suspended particles. Particulate phosphorus was generally most biologically available in winter in all three rivers and in the Bow River in all seasons. Particulate phosphorus was least biologically available in spring in all three rivers, at sites above Calgary and Lethbridge in all seasons, and in the Oldman River in all seasons.

Particulate biologically-available phosphorus may be utilized by the biological community, but the mechanism is likely of secondary importance. Therefore, dissolved phosphorus was the form utilized to develop functional relationships for growth by aquatic weeds and algae. (Part II, The Primary Producers).

Climatological and physical factors predominated over nutrient limitations of primary production during winter, and to varying degrees in spring and fall. Nutrient limitation of primary producers was the controlling factor during summer.

In summer high ratios of nitrogen to phosphorus, low absolute concentrations and similarity of results between algal growth potential tests indicated that phosphorus was more limiting to growth above Calgary and Lethbridge. Phosphorus was also more limiting at sites in the lower Bow and Oldman Rivers nearer their confluence and at sites on the South Saskatchewan River.

Data from sites on the Bow River from below Calgary to Bassano had low nitrogen to phosphorus ratios and high absolute concentrations. These data, plus the algal growth potential data, indicated that there was no nutrient limitation at these sites.

In the Oldman River below Lethbridge, nitrogen to phosphorus ratios were low, and absolute concentrations were low. Nitrogen additions had a significant effect on algal growth potential tests. These results suggested that nitrogen could be controlling primary production at this location in summer.

Sediment phosphorus in the South Saskatchewan River Basin was not a major source contributing to plant growth because of its small quantity relative to phosphorus in the water column and low overall bioavailability (12 to 35%).

Concentrations of all phosphorus forms in sediments were lowest at sites upstream of Calgary and Lethbridge and substantially higher at downstream sites, particularly below Calgary. Concentrations returned to low values in the South Saskatchewan River at sites above Medicine Hat.

The non-apatite inorganic form of phosphorus was correlated to the biologically available fraction of the sediment, though some organic phosphorus should become available over the longer term. These fractions built up through fall and winter below Calgary and Lethbridge and decreased through spring and summer. This seasonal trend was related to adsorption and desorption of phosphates from the water column, decomposition of macrophytes and algae, and suspension and transport of sediments by high spring discharges.

Yearly variation in total phosphorus loading was highest in the Oldman River because of its higher component of suspended material, and the correlation of this material with discharge.

The phosphorus source inventory for the South Saskatchewan River Basin, derived from total phosphorus data, indicated that 34% of the total phosphorus came from upstream sources and 54% came from the sewage treatment plants. In contrast, using dissolved phosphorus data, the importance of the sewage treatment plant inputs rises to 89% (70% from Calgary, 14% from Lethbridge and 5% from Medicine Hat). The inventory that used dissolved phosphorus reflected the component of the total phosphorus which is more available for use by the biological community.

Within each river sub-basin, Calgary, Lethbridge and Medicine Hat sewage treatment plants contributed 91%, 78% and 12% respectively, of the dissolved phosphorus loadings. Upstream sources contribute 2%, 17% and 87% respectively. The highest contribution of phosphorus from irrigation return flow and industrial effluent was in the Oldman River at 3% and 2%, respectively.

Through 1980 and 1981, there was a net uptake in the basin of 75% of the dissolved phosphorus. The net uptake was incorporated into more permanent primary producers and secondary producers, but a substantial amount was lost from the basin in drifting, senescent macrophytes. This was not quantified.

In conclusion, water chemistry within the South Saskatchewan River Basin study area followed typical seasonal changes in concentration. Calgary had the most significant impact on the supply of plant nutrients to the river basin, although the contribution from Lethbridge to the Oldman River was substantial. The river below Calgary exhibited the most dynamic cycling of the plant nutrient, dissolved phosphorus.

6.0 CONCLUSIONS

Water chemistry throughout the Basin showed typical seasonal changes related to climate, discharge and biological activity. Water chemistry in the South Saskatchewan River often showed trends which were intermediate, or a combination of trends in the Bow and Oldman Rivers.

Changes in nutrient concentrations over a year reflected changes in plant utilization for growth and release upon senescence. The most dramatic uptake of phosphorus by plants occurred in the Bow River from Calgary to Bassano during summer and fall.

Dissolved phosphorus gave a good estimate of dissolved biologically-available phosphorus. Therefore, dissolved phosphorus was the form utilized in developing functional relationships between phosphorus and aquatic plant and algal growth (Part II, The Primary Producers, Charlton et al., 1986).

Climatological and physical factors predominated over nutrient limitations of primary production during winter, and to varying degrees in spring and fall. Nutrient limitation of primary producers was the controlling factor during summer. There was no nutrient limitation at the sites on the Bow River from below Calgary to Bassano. Phosphorus was more limiting to plant growth at all the other sites in the Basin except in the Oldman River below Lethbridge. Nitrogen could be controlling primary production at this location in summer.

The sewage treatment plants are the largest source of dissolved phosphorus in the Basin (89%). Calgary contributed 91% of the dissolved phosphorus to the Bow River, Lethbridge contributed 78% to the Oldman River and Medicine Hat contributed 12% to the South Saskatchewan River.

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8.0 APPENDIX A

8.1 Technical Study - Introduction

The development of any routine sampling program requires a review of technical considerations related to analytical as well as sampling methods. Three studies were carried out to address these concerns.

In the first study, GFC-filtered and membrane-filtered samples were collected at each site to determine if results were comparable. Sample filtering was often very time consuming and expensive since membrane filters clogged rapidly, especially in the spring. Substitution of GFC-filtered water would reduce these effects. The second, a precision study, tested the variation introduced by sampling procedure and chemical analysis for each field sampler.

The third study tested the bias introduced into the routine water chemistry data from following a repetitive sampling route and schedule. Fluctuations in nutrients introduced into the Bow River by the Bonnybrook sewage treatment plant effluent were of particular interest. Variability in nutrient concentration may be complicated even further by variation in discharge flow rates and may differ seasonally. Therefore, the diurnal variation of selected variables was investigated at four sites on the Bow River, five times throughout the year.

8.2 Methods

Filter comparison tests were performed on duplicate samples collected at all regular sampling sites during the first year of data collection. The samples were treated equally in every way except for the use of a GFC filter in one case and a 0.45 μ membrane filter in the other. Wilcoxon matched pairs tests were carried out to test for significantly different results.

A precision study was carried out in spring 1980 and 1981 by each of the field personnel who collected regular water chemistry samples and data. Conditions of high and low nutrients were sampled on the Bow River at Stiers Ranch below Calgary (Site 2) and below Bearspaw Dam above Calgary (Site 1), respectively (Figure 1). Five discrete replicate samples were collected by each field sampler at each site. Sartorius membrane filters (0.45 μ) were used for all filtrations with one exception - samplers #2 and #3 used GFC filtrate for dissolved nitrogen analysis. The mean, standard deviation, and coefficient of variation were calculated for each variable and sampler.

The diurnal variability study was carried out at four sampling locations (Figure 1): above Calgary (Site 1), in the Bonnybrook sewage treatment plant effluent (Site 1.5), at Stiers Ranch (Site 2) and below the Carseland Weir (Site 5). Locations and sampling dates are given in Table A-1. Ten samples were collected over a 24-hour period at four-hour intervals, with more frequent sampling during one 4-hour period at 15 minutes, 1 hour and 2 hours. The period of more intensive sampling was judged to be about the time of maximum sewage

TABLE A-1 SAMPLING SITES AND DATES FOR WATER CHEMISTRY DIURNAL VARIABILITY STUDY ON THE BOW RIVER

Sampling Location	Site	Late Spring 1980	Summer 1980	Fall 1980	Winter 1981	Early Spring 1981
Below Bearspaw Dam or at 85th St. Bridge	1	02-03/06	11-12/08	06-07/10	05-06/01	23-24/03*
Bonnybrook Sewage Treatment Plant Effluent	1.5	09-10/06	05-06/08	27-28/10	15-16/01	25-26/03
At Stier's Ranch	2	05-06/05	28-29/07	20-21/10	12-13/01	30-31/03
Below Carseland Weir	5	12/13/05	21-22/07	13-14/10	20-21/01	18-19/03

*Sampling repeated on 08-09/03/82

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treatment plant effluent discharge, taking into account the lag time to downstream sites (Water Survey of Canada).

The variables measured were pH, conductivity, temperature, dissolved oxygen (DO), total phosphorus (TP), dissolved phosphorus (DP), dissolved reactive phosphorus (OP) and dissolved nitrogen (DN). During late spring and summer physical variables were measured in the field using a Hydrolab Surveyor Model 6D. The exception was at Site 1 in June when lab measurements of pH and conductivity were made. During fall, winter and early spring, pH and conductivity were measured in the lab, and temperature and dissolved oxygen were measured by thermometer and Winkler titration, respectively.

Dissolved nutrient variables were field filtered through 0.45 μ Sartorius membrane filters, and at Site 1.5 samples were prefiltered through GFC filters to reduce clogging of membrane filters.

A one-way analysis of variance was used to determine if sites or seasons were significantly different. The homogeneity of the variances between seasons was tested using the ratio of maximum to minimum variance. A level of 20 was used to determine significance (Green, 1979). The coefficient of variation was used to determine the variability within each test (10% level of significance).

8.3 Results

8.3.1 Filter Comparison

The filtrates from GFC and membrane filtered samples for the three dissolved phosphorus forms were significantly different when the data from all the seasons were tested (Table A-2). Spring and fall data also show significant differences for two of the three forms. At individual sites - Sites 10 and 11 on the South Saskatchewan River and Sites 6, 13 and 7 on the Bow River - there were significant differences in at least one form. Each river individually showed a significant difference in one of the phosphorus forms. In all cases the average value for the GFC filtrate was greater than the average value for the membrane filtrate.

The nitrogen filtrate data were significantly different only in three cases: for dissolved nitrogen at Site 4 on the Oldman River; on the Oldman River data in total; and for nitrate/nitrite, at Site 2 on the Bow River. The membrane filtrate was greater than the glass fibre filtrate. This suggested that there were some contamination problems. Occasional ammonia contamination was noted previously (M. Korchinski, pers. comm.) and membrane filters without dividers were used to try to eliminate this problem.

The carbon filtrate data were available only from January to May 1980, and, therefore, summer and fall data were not tested. Dissolved inorganic carbon (DIC) showed a significant difference overall, and both dissolved inorganic carbon and dissolved organic carbon (DOC) showed significant filtrate differences in spring. The Bow River data showed a significant difference for dissolved inorganic carbon, as did Sites 12 on the South Saskatchewan River and Site 13 on the Bow River. Again, the membrane filter values were higher.

TABLE A-2 SUMMARY OF SIGNIFICANCE OF WILCOXON MATCHED PAIRS TEST RESULTS FOR COMPARISON OF DISSOLVED VARIABLES FROM GFC AND 0.45 μ MEMBRANE FILTRATE (*$p < 0.05$, **$p < 0.01$)

Dataset	n	DP	DIP	OP	DN	NIT	n	DIC	DOC
ALL	257-272	**	**	*			113-115	**	
SEASONAL									
Spring	74-83		**	**			56-58	**	**
Summer	50-54						-		
Fall	54-58	**	**				-		
Winter	73-77						57		
RIVER									
Oldman	58-61		*		**		24-25		
S. Saskatchewan	80-85	**					35-36		
Bow	118-126	*		*			54	**	
SITE									
3	19-20						7-8		
4	19-21				**		9		
8	19-21						8		
9	21-22						9		
10	18-21	**	*				9		
11	19-21		*				8-9		
12	19-21						9	*	
1	20-22						9		
2	19-22					*	9		
5	21-22						9		
6	22-25	**					9		
13	13-14	*					9	*	
7	20-22		*	**			9		

8.3.2 Precision

A summary of means, standard deviations, and coefficient of variation for the precision study data are presented in Tables A-3 and A-4 for each sampler. A coefficient of variation greater than 10% was considered significant. Normal data scrutiny was carried out and resulted in enquiries about 44 individual results, 7.5% of the data. Ten results were omitted or rejected because of sample loss or obvious contamination. Seven results were corrected because of recording errors, and the remainder were confirmed to be accurate results.

At low nutrient levels (Table A-3), single outliers in the nitrate/nitrite data for Sampler #1 and in the dissolved nitrogen data for Sampler #3 were responsible for their low precision. The phenolphthalein alkalinity data for Sampler #1 cover a range of results, and suggested an inherent analytical imprecision near detection limits. The variables that depended on the suspended portion of the sample (non-filterable residue fixed, non-filterable residue, particulate nitrogen, particulate organic carbon, and turbidity) had a lower precision in many cases. This was not unexpected for analyses involving particulate matter and must be considered in interpretation of the routine water chemistry data.

Phosphorus concentrations that approached the detection limit would be expected to show poorer precision. In the case of total phosphorus (TP), however, another problem was encountered. When reviewing the data for Sampler #1, carry-over during lab analysis from

TABLE A-3 MEAN, STANDARD DEVIATION (SD) AND COEFFICIENT OF VARIATION (CV) FOR DATA FROM WATER CHEMISTRY PRECISION STUDY ON THE BOW RIVER BELOW BEARSPAW DAM

Variable	Sampler #1 n=5, 02/06/80			Sampler #2 n=4, 02/06/80			Sampler #3 n=5, 01/06/81		
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
Conductivity	256.2	1.79	1	268.3	1.71	1	268.2	2.59	1
Turbidity	3.98	0.409	10	3.80	0.141	4	24.6	0.55	2
Carbon - DOC	2	0	0	2	0	0	2.4	0.14	6
- DIC	21.2	0.84	4	21	0	0	25	0	0
- POC	0.276	0.0251	9	0.205	0.0100	5	0.536	0.0702	13
Nitrogen - NIT	0.054	0.0261	48	0.055	0.0058	11	0.09[b]	0	0
- NH_3	L0.1	0	0	L0.1	0	0	L0.1	0	0
- DN	0.116	0.0055	5	0.165	0.0129	8	0.194	0.0709	37
- PN	0.044	0.0055	13	0.030	0.0141	47	0.052	0.0045	9
Alkalinity - total	105.4	4.93	5	101.8	1.26	1	108.8	0.45	0
- phenolphthalein	0.6[a]	0.34	57	0	0	0	0	0	0
pH	8.5	0	0	8.2	0	0	8.1	0	0
Residue - NFR	3.8	0.45	12	4.0	1.15	29	25.8	1.64	6
- NFFR	3.6	0.55	15	3.5	1.29	37	23.0	1.23	5
Silica - Si	3.88	0.179	5	4.05	0.100	2	4.3	0	0
Phosphorus* - DP	3.2	0.45	14	3.3	0.50	15	3.4	0.89	26
- OP	3	0	0	3.3	0.50	15	L3	0	0
- TIP	3	0	0	3.5	0.58	17	15.4	5.03	33
- DIP	L3	0	0	L3	0	0	L3	0	0
- TP	5.6	3.71	66	11.8	4.79	41	19.6	2.07	11
Chloride - Cl	0.92	0.045	5	0.93	0.050	5	0.9	0	0

	n=5, 12/09/80			n=5, 09/09/80		
Conductivity	307.0	0.71	0	303.3	2.06	1
Turbidity	2.04	0.297	15	1.93	0.222	12
Alkalinity - total	113.6	1.14	1	111.0	0	0
pH	8.22	0.045	0	8.3	0	0
Silica - Si	3.7	0	0	3.60	0.115	3
Phosphorus - TP	3	0	0	4.0	1.41	35
Chloride - Cl	1.0	0	0	1.0	0	0

Measurement units are given in Table 1

* µg/L

[a] n = 4

[b] n = 1

TABLE A-4 MEAN, STANDARD DEVIATION (SD) AND COEFFICIENT OF VARIATION (CV) FOR DATA FROM WATER CHEMISTRY PRECISION STUDY ON THE BOW RIVER AT STIERS RANCH

	Sampler #1 n=5, 20/05/80			Sampler #2 n=4, 20/05/80			Sampler #3 n=5, 02/06/81		
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
Conductivity	309.8	7.16	2	309.5	0.58	0	305.0	2.45	1
Turbidity	3.28	0.540	16	2.95	0.592	20	48.0	5.79	12
Carbon - DOC	2	0	0	2	0	0	3.5	0.19	5
- DIC	22	0	0	22	0	0	27.8	0.45	2
- POC	1.20	0.141	12	0.934	0.2549	27	1.18	0.164	14
Nitrogen - NIT	0.398	0.0045	1	0.393	0.0096	2	0.36	0	0
- NH_3	0.46	0.152	33	0.40	0.163	41	L0.1	0	0
- DN	0.792	0.0396	5	0.838	0.0050	1	0.744	0.2587	35
- PN	0.176	0.0230	13	0.135	0.0191	14	0.158	0.0164	10
Alkalinity - total	104.3[a]	2.75	3	106.0	0.82	1	121.0	1.87	2
- phenolphthalein	0	0	0	0	0	0	0	0	0
pH	8.0[b]	0	0	8.2	0	0	7.68	0.130	2
Residue - NFR	11.2	2.59	23	9.3	1.71	18	81.4	14.10	17
- NFTR	7.8	2.28	29	8.5	2.08	24	72.2	13.77	19
Silica - Si	3.72	0.303	8	3.33[b]	0.115	4	4.96	0.548	11
Phosphorus* - DP	126.0	5.48	4	150	0	0	34.4	1.82	5
- OP	105.2	6.72	6	130	0	0	23.4	2.61	11
- TIP	162.0	13.04	8	170.0	21.60	13	78.8	3.77	5
- DIP	112.0	8.37	8	137.5	5.00	4	30.2	2.39	8
- TP	192.0	4.47	2	205.0	5.77	3	99.2	6.53	7
Chloride - Cl	2.66	0.089	3	3.0[b]	0	0	1.74	0.055	3

Measurement units are given in Table 1

* μg/L

[a] n=4

[b] n=3

a previous extremely high sample was not identified. Therefore, the analysis should have been repeated. No similar explanation was obvious for Sampler #2. Several variables were retested by Samplers #1 and #2 on September 9 and 12, 1980 (Table A-3). The results for total phosphorus indicated a low precision when levels were close to the detection limit.

At high nutrient levels (Table A-4) the poor precision in particulate nitrogen, particulate organic carbon, turbidity, non-filterable residue and non-filterable residue fixed reflected the same difficulty with particulate determination at high nutrient levels as at low nutrient levels. The consistently poor precision in ammonia was inherent to the lag time between sampling and analysis. The relatively poorer precision in total inorganic phosphorus for Sampler #2 was caused by a single outlier, while the poor precision in dissolved nitrogen for Sampler #3 was caused by a range of measured values.

8.3.3 Diurnal Variability

The mean, standard deviation, and coefficient of variation of each variable at each site is summarized in Table A-5, and the summer and early spring data for selected variables are presented graphically in Figure A-1. The remainder of the data are presented in Appendix Table B-1.

Site 1, which represented background levels, showed only minor fluctuations over each 24-hour period, particularly in conductivity and nutrients. Conductivity fluctuated with higher values from about

TABLE A-5 MEAN, STANDARD DEVIATION (SD) AND COEFFICIENT OF VARIATION (CV) OF DATA FROM DIURNAL VARIABILITY STUDY ON THE BOW RIVER

Variable	Site 1			Site 1.5			Site 2			Site 5	
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV	Mean	SD
Late Spring											
Conductivity	266.9	0.3	0	1095	69	6	365.5	8.0	2	321.0	10.5
Temperature	10.5	0.6	6	14.9	0.3	2	12.4	1.3	11	12.4	0.7
DO	10.3	0.1	1	3.9	0.2	5	10.4	2.1	21	10.8	1.6
pH	8.27	0.05	1	7.35	0.05	1	7.99	0.31	4	8.09	0.35
DN	0.108	0.006	6	16.98	2.97	18	1.13	0.17	15	0.875	0.126
DP	3.2	0.6	19	3410	600	18	181	20	11	101	12
OP	3	0	0	3300	640	19	141	20	14	62	13
TP	8.5	4.7	55	3730	760	20	237	21	9	142	8
Summer											
Conductivity	274.4	4.6	2	1015	64	6	308.5	14.0	4	296.0	11.0
Temperature	15.2	0.3	2	18.1	0.4	2	19.5	1.5	8	19.7	0.8
DO	10.3	0.4	4	3.9	0.2	4	7.1	2.2	31	7.8	1.7
pH	8.17	0.05	1	7.47	0.05	1	8.01	0.53	7	8.34	0.30
DN	0.038	0.004	11	12.45	2.29	18	1.23	0.18	14	0.891	0.100
DP	3	0	0	3680	580	16	169	38	23	121	14
OP	3	0	0	3430	60	31	146	40	27	98	8
TP	8.8	4.2	48	4100	770	19	189	42	22	153	14
Fall											
Conductivity	320.2	3.6	1	932	65	7	368.6	8.4	2	370.8	3.4
Temperature	4.7	0.8	17	16.4	0.7	4	10.8	0.4	4	6.7	0.8
DO	13.4	0.3	2	4.1	0.1	1	8.4	1.6	20	11.1	0.7
pH	8.32	0.04	0	7.72	0.04	0	7.79	0.14	2	8.19	0.12
DN	0.052	0.006	12	13.80	1.62	12	1.34	0.13	15	1.20	0.12
DP	3	0	0	3940	660	17	190	28	14	161	20
OP	3	0	0	3850	660	17	182	26	11	149	22
TP	3.2	0.6	19	4370	760	17	220	24	13	173	21
Winter											
Conductivity	350.9	1.5	0	822.6	116.1	14	396.4	7.1	2	399.1	6.9
Temperature	0	0	0	NV			1	0	0	0.7	1.2
DO	13.8	0.18	1	9.2	1.9	20	12.2	0.3	3	11.4	0.1
pH	8.21	0.06	1	7.79	0.12	2	7.85	0.07	1	7.87	0.12
DN	0.121	0.003	2	13.90	4.69	34	1.15	0.19	16	1.16	0.07
DP	3.5	1.6	46	3050	720	24	255	26	10	192	10
OP	L^3	0	0	2770	1060	38	244	28	12	182	10
TP	6.5	3.5	54	3330	760	23	286	28	10	207	18
Early Spring											
Conductivity	313.3	1.9	1	932.3	70.4	8	408.8	16.6	4	396.9	6.7
Temperature	3.2	0.3	10	9.8	0.8	8	4.7	0.7	14	1.8	0.8
DO	12.3	0.6	5	4.8	0.6	12	9.8	0.4	4	11.8	0.7
pH	8.05	0.05	1	7.60	0	0	7.63	0.07	1	8.50	0.16
DN	0.161	0.041	26	22.30	3.47	16	2.35	0.32	14	1.60	0.15
DP	L^3	0	0	3060	270	9	302	30	10	194	14
OP	L^3	0	0	2780	740	27	293	37	13	171	17
TP	5.4	2.0	37	3140	300	10	401	33	8	231	15

Measurement units for each variable are given in Table 1 except for phosphorus (µg/L)

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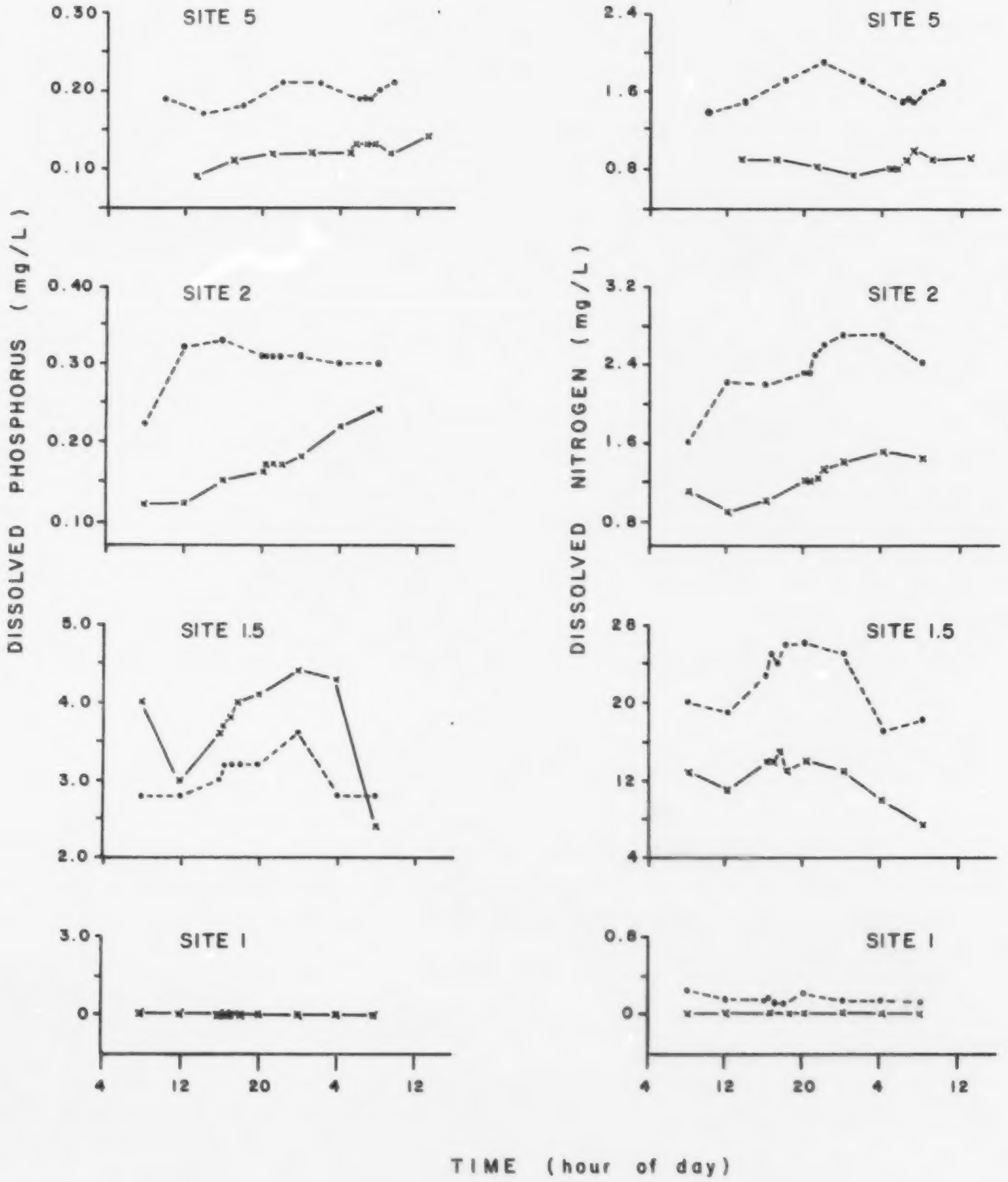

Fig. A-1 Diurnal variability study results for dissolved phosphorus, dissolved nitrogen, dissolved oxygen and conductivity. March (·----·), July/August (x——x)

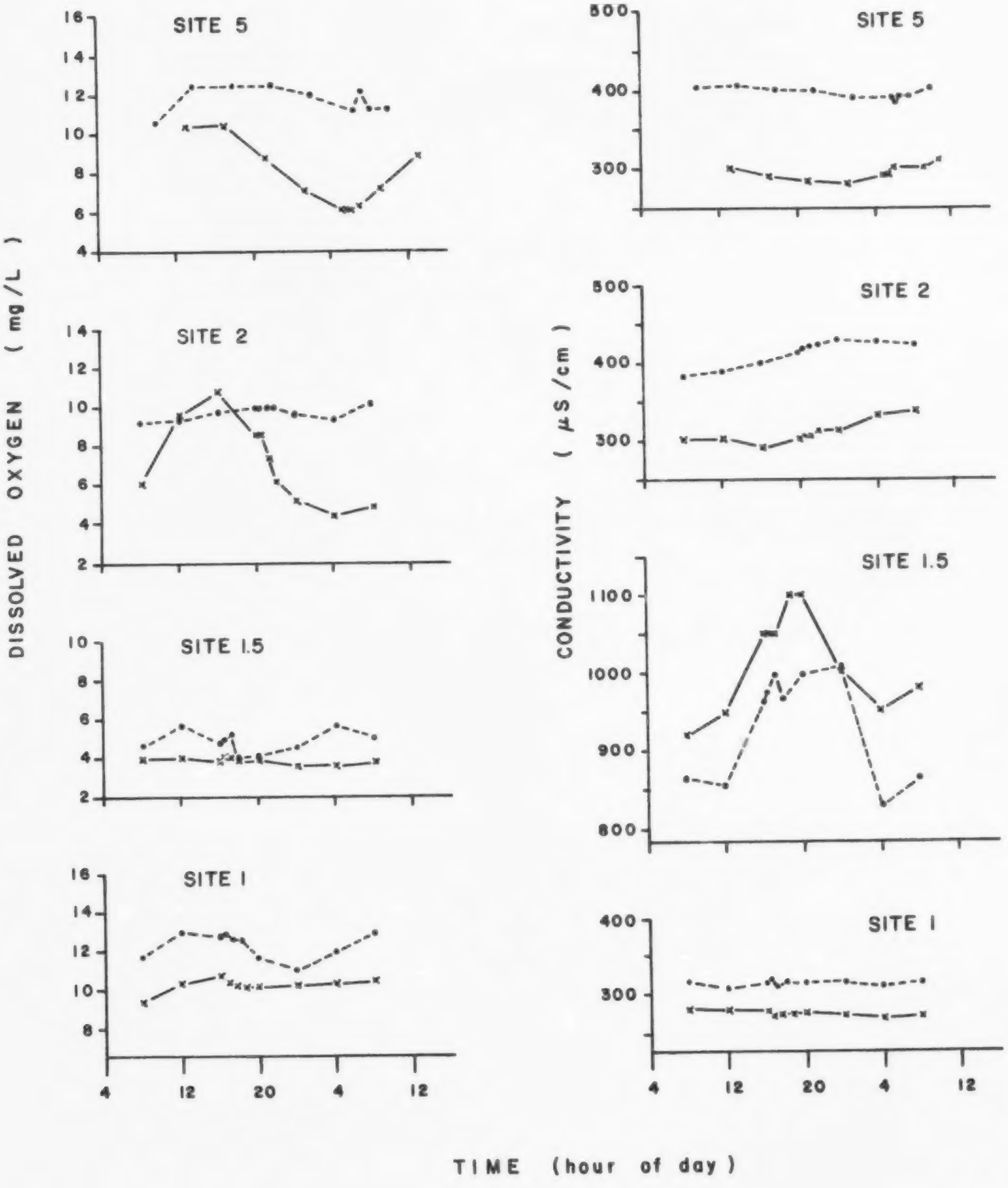

Fig. A-1(Continued)

16:00 to 24:00 hours and lower values at about 04:00 to 08:00 hours. Nutrient concentrations followed a similar pattern. Phosphorus values were generally highest at 24:00 hours (slightly earlier in winter) and nitrogen values peaked at about 16:00 to 20:00 hours.

Diurnal patterns were evident at Site 2 for most physical variables, though they were less pronounced in winter and early spring. Conductivity was generally highest at night, while pH and dissolved phosphorus were highest in the afternoon and lowest at night. The diurnal fluctuation of conductivity and nutrients was partially masked by the general upward trend over each sampling period.

Site 5 showed lower size in the diurnal fluctuations than Site 2, and masking by the upward trend was less evident. Nutrients were generally higher in the early morning in late spring and summer, and in late evening for the other three sampling periods.

Analysis of variance was carried out for the two downstream river sites, Sites 2 and 5, to determine if there was an overall significant difference between them as well as within each season (Table A-6). None of the variances were significantly different, but with all of the seasons combined, pH and the four nutrients were all significantly different between sites. On a seasonal basis, conductivity was significantly different only in late spring. Temperature, dissolved oxygen and pH were different in early spring and fall. Dissolved oxygen was also significantly different in winter. Phosphorus values were significantly different in all cases, except total phosphorus in summer and dissolved phosphorus in fall. Dissolved nitrogen values were significantly different except in fall and winter.

TABLE A-6 SUMMARY OF F-RATIOS AND RATIOS OF MAXIMUM TO MINIMUM VARIANCE FROM ONE-WAY ANALYSIS OF VARIANCE ON DIURNAL VARIABILITY STUDY DATA (*F-RATIO $p < 0.01$, VARIANCE RATIO > 10)

	ALL DATA		SITE 1		SITE 1.5		SITE 2		SITE 5	
Variable	F-Ratio	Max:Min Variance	F-Ratio	Max:Min Variance	F-Ratio	Max:Min Variance	F-Ratio	Max:Min Variance	F-Ratio	Max:Min Variance
Temperature	205*	39*	1441*	6	351*	7	558*	12	864*	2
Dissolved Oxygen	17*	4	203*	12	61*	129*	16*	40*	19*	151*
pH	0.4	5	43*	2	76*	8	2	63*	11*	9
Conductivity	0.1	3	1490*	216*	17*	3	115*	5	319*	10
Total Phosphorus	0.2	2	5*	50*	5*	7	75*	4	54*	7
Dissolved Phosphorus	0.1	2	0.8	1457*	4*	7	38*	4	84*	4
Ortho Phosphorus	0.2	2			3	17	45*	4	115*	7
Dissolved Nitrogen	1.1	3	72*	168*	15*	8	61*	7	65*	5

F-RATIOS FOR SITES 2 AND 5

	All	Late Spring	Summer	Fall	Winter	Early Spring
Temperature	1.1	0.0	0.2	234.0*	0.4	78.0*
Dissolved Oxygen	5.2	0.2	0.6	23.3*	51.0*	62.4*
pH	25.9*	0.5	2.9	48.3*	0.1	261.0*
Conductivity	2.6	114.1*	4.9	0.6	0.7	4.4
Total Phosphorus	46.6*	185.9*	6.6	21.6*	57.0*	224.6*
Dissolved Phosphorus	42.7*	114.2*	14.0*	7.1	51.0*	107.1*
Ortho Phosphorus	35.2*	107.3*	13.8*	9.6*	44.4*	89.9*
Dissolved Nitrogen	12.5*	14.0*	27.4*	6.7	0.1	44.2*

The coefficient of variation (CV) can be used to compare the variability of measurements within each sampling series at different seasons and sites (Table A-5). Greater than ten percent was chosen as being significant. For the physical variables the coefficient of variation was never significant for pH and only once (winter at Site 1.5) for conductivity. Temperature was more variable, with significant values at Site 1 in fall, at Site 2 in late and early spring, and at Site 5 in fall, winter and early spring. However, these significant values are based on very low mean values and absolute variation was low.

The coefficient of variation for dissolved oxygen was significant at Site 1.5 in winter and early spring. However, at Sites 2 and 5 it was significant in late spring, summer and fall. In each case the coefficient of variation at Site 5 was lower than that at Site 2.

At Site 1 a significant coefficient of variation for the nutrient variables often indicated the difficulty in making measurements near the detection limits of the analyses. At Site 1.5, however, concentrations were high and the consistently significant coefficients of variation indicated clearly a high degree of variability within these nutrient variables over a 24-hour period.

The downstream effects at Sites 2 and 5 are different both among seasons and among variables. In late spring the coefficient of variation for total phosphorus was reduced below significance at both downstream sites. Dissolved phosphorus and dissolved nitrogen were lower downstream but showed no change between Sites 2 and 5, and the coefficient of variation for dissolved reactive phosphorus increased within that reach. In summer the variability of nutrient measurements was high at Site 2 and markedly decreased by Site 5. Results from fall showed no strong change in the coefficient of variation in downstream sites. Winter coefficients of variation at Site 2 were similar to fall values, but at Site 5 no values were significant. In early spring results at Site 2 were similar to those in late spring, while Site 5 results had generally dropped below the level of significance.

An analysis of variance was run on all the sites combined and at each site individually to determine any significant seasonal differences (Table A-6). Overall, only temperature and dissolved oxygen were significantly different between seasons. However, when each site was treated individually, the seasonal differences between most variables were significant. The exceptions were dissolved phosphorus and dissolved reactive phosphorus at Site 1, dissolved reactive phosphorus at Site 1.5, and pH at Site 2.

The homogeneity of the variances (Table A-6) was used to determine any significant seasonal differences in variability overall and at each site. A ratio of maximum variance to minimum variance of greater than twenty was considered significant. When all the data were combined, only temperature variation was seasonally significantly different. When each site was treated separately, Site 1 showed the most seasonal differences in variation, with conductivity, total phosphorus, dissolved phosphorus and dissolved nitrogen all being significant. At the other sites only variation for dissolved reactive phosphorus at Site 1.5, temperature and pH at Site 2, and conductivity at Site 5 were significantly different seasonally.

8.4 Discussion

8.4.1 Filter Comparison

The filter comparison testing showed that glass fibre filters are not always an acceptable substitute for 0.45 µ membrane filters for field filtering. The uses of membrance filter or glass fibre filter have their advantages and disadvantages. The effective pore size of the former changes when large particles are present and clogging occurs rapidly (Danielsson, 1982). The latter has a greater dirt-holding capacity, although contamination is a problem (pore size covers a range from 0.8 to 1.2 µ for GFC).

Results suggestd that there was a fraction of both carbon and phosphorus in the size range from 0.45 µ to 0.8-1.2 µ. The significance of that fraction varied with season and by river and, therefore, results from GFC and membrane filtered water were not always interchangeable. Therefore, dissolved variables were measured on 0.45 µ membrance filtered water for the remainder of the project, since this was the more common functionally-defined determination of a dissolved parameter.

The results with dissolved nitrogen were less clear since the membrane filtered results were higher than the GFC filtered results. Significant results were restricted to the Oldman River for dissolved nitrogen, and Site 2 on the Bow River for nitrate/nitrite. Steps were taken to remove possible ammonia contamination caused by membrane filter dividers; but dissolved nitrogen measurements were made on GFC filtered water for the remainder of the project, since particulate nitrogen was determined on GFC filters.

8.4.2 Precision

A generally acceptable level of precision was attained for most variables in the routine water chemistry under conditions of both high and low nutrients. Only outliers which could be rejected on the basis of documented field or lab problems were excluded. Remaining outliers represented 0.5% of the data. This conservative data treatment ensures that data are not rejected simply for being difficult to explain.

There were three major factors affecting precision: 1) inherent instability caused changes between the time of collection and analysis (e.g., ammonia); 2) the discrete nature of suspended particles made them difficult to sample uniformly (e.g., particulate nitrogen, particulate organic carbon, turbidity, non-filterable residue, non-filterable residue fixed); and 3) precision was lost near the limits of analytical precision (e.g., low nitrogen and phosphorus forms). Similar conclusions about factors affecting precision have been reached by Chacko, Chu and Gummer (1981) on studies of the Red River in Manitoba and by Oguss and Erlebach (1976) on studies of the Thompson River in British Columbia.

Precision of a measurement is particularly important when the seasonal variation is considered. Precision study results indicated that samples collected throughout the limnological study have a precision of about ±5%. Changes in concentration at the limits of detection are relatively less precise (±10%), and trends should be interpreted with caution. Similarly, calculations of phosphorus loading that used concentrations near the detection limits should be used cautiously.

Trends in variables related to suspended particles must also be established beyond the levels of precision (±15-20%) before they can be considered significant. Again, calculation of total phosphorus loading, under conditions of high suspended sediment load, would carry this qualification. Total phosphorus loading at sites where the total phosphorus concentration is near the detection limit would carry an uncertainty factor of ±25% on the basis of precision alone.

8.4.3 Diurnal Variability

Diurnal variability in phosphorus concentrations input by sewage treatment plants is a complicating factor in the understanding of the phosphorus removal process by the river (Verhoff and Baker, 1981). Our study showed that sewage treatment plant effluent is a seasonally variable source of nutrients to the river with a consistently high diurnal variation. The dissolved nutrients variability was evident most strongly in the summer at Site 2. It was reduced by Site 5 particularly in summer, winter and early spring. Total phosphorus variation acted somewhat differently. It was reduced by Site 2, except in summer and fall, and remained significant only at Site 5 in fall.

The seasonal differences found in this study suggested that discharge and biological activity in the river were affecting the diurnal variability introduced by the sewage treatment plant effluent. Discharge acts in two ways. First, the degree of dilution of effluent reduced the variation during periods of high flow. This may have accounted for a basic diurnal variability in dissolved nutrients of about 10%, as shown in fall, winter and early spring (or 5% more than was accounted for by precision). Second, the amount of suspended material transported by the river varied with discharge. During periods of high flow, more suspended solids can be carried (Keup, 1968). This would affect the settling of the particulate fraction of the total phosphorus introduced at the sewage treatment plant.

Biological activity and uptake of dissolved nutrients for primary production was more evident in late spring, and particularly in summer. Studies on the Sandusky River below Bucyrus, Ohio, determined that 75% of the phosphate input at the sewage treatment plant was removed in 16 km (Verhoff and Baker, 1981). Biological utilization was a more significant factor than adsorption to particulate in this removal. Aiba and Ohtake (1977) studies the Tama-gawa River in Tokyo, Japan, during August and found that 44% of the phosphate was retained in 20 km of river. They also found that 34% of the phosphate removal was attributable to algal fixation. The uptake may vary diurnally since it is related to plant photosynthesis, and this could act to reinforce the trends apparent in our variability study. This hypothesis, however, could not be evaluated with data from this study.

A second effect of biological activity was related to the large macrophyte community below the sewage treatment plant. This community senesced in the fall, and provided an additional source of particulate phosphorus to the river. This source contributed to total phosphorus variation at Sites 2 and 5, particularly in the fall.

The variability study provided valuable information for data interpretation. The consistently high diurnal nutrient variability at Site 2 must be considered when data trends are discussed. This consideration is less important at Site 5 in the summer, winter and early spring than it is in late spring and fall. The effect of nutrient variability introduced by the Calgary sewage treatment plant effluent would be expected to decrease at sites further downstream on the Bow River.

Lethbridge and Medicine Hat probably produced sewage treatment plant effluent with a similar diurnal variability. The strongest impact would have been at Site 4 below Lethbridge in summer. In general, however, the impact of these cities would be less severe since the relative nutrient input is much lower.

An additional factor must be considered when the results of the diurnal variability study are applied to the interpretation of the routine water chemistry results. The studies were conducted immediately after a weekend and reflect a maximum variation over a 24-hour period for two reasons: 1) sewage effluent flows are lower over the weekend (55-57 MIGPD on Saturday and Sunday versus 63-68 MIGPD on Monday to Friday); and 2) the quality of the weekend effluent was probably better than during the week because of the different contribution of light industry and household activities (Joe Kostler, personal communication).

The upper Bow River sites generally were sampled for routine water chemistry immediately following a weekend. Therefore, the concentrations of nutrients that were measured might be about 5% lower than if they were measured later in the week, and particularly if samples were collected in the early morning rather than the late afternoon. The largest potential underestimate would occur at Site 2 in summer (10%), a fact to be considered in discussions of seasonal variation as well as in interpretation of any calculations using the routine chemistry data to determine nutrient loadings and within reach characteristics.

8.5 Summary

Filter comparison testing showed that glass fibre filters were not always an acceptable substitute for 0.45 μ membrane filters for field filtering.

A generally acceptable level of precision was attained for most water chemistry variables under conditions of both high and low nutrients. Levels of precision were about ±5% for most variables, ±10% for concentrations at the limits of detection and ±15-20% for variables related to suspended particulates.

The Calgary sewage treatment plant effluent was a seasonally variable source of nutrients to the river with a consistently high diurnal variability. The effects of river discharge and biological activity in the river resulted in seasonal differences in the impact of this variability on the river. River flows provided variable dilution and suspended sediment carrying capacity. Biological activity included photosynthetic uptake of phosphorus by aquatic plants during summer and release because of senescence of macrophytes in the fall. The diurnal variability in nutrient concentrations was most pronounced at Site 2 (below Calgary) in general, and less so at Site 5 (Carseland) in summer, winter and early spring. As a consequence of sampling times, routine data may be about 5% low at these sites and potentially as much as 10% too low at Site 2 in summer.

8.6 REPORT APPENDIX TABLES AND FIGURES

TABLE: A-7 PEARSON'S CORRELATION BETWEEN SELECTED WATER CHEMISTRY VARIABLES

Variables	ALL	BOW	OLDMAN	S. SASK.
DIC vs ALK	.85	.76	.91	.84
ALK vs COND	.79	.74	.83	.76
DIC vs COND	.70	.60	.76	.72
COND vs CL	.64	.74	.77	.68
PN vs POC	.85	.70	.98	.95
PN vs PP	.66	.70	.79	.73
POC vs PP	.79	.87	.87	.91
NFR vs NFFR	.9999	.999	.99997	.999
TURB vs NFR	.96	.76	.97	.84
PN vs TURB	.53	.39	.70	.64
PN vs NFR	.56	.50	.78	.50
POC vs TURB	.69	.64	.83	.74
POC vs NFR	.72	.77	.89	.57
PP vs NFR	.95	.69	.98	.77
PP vs TURB	.95	.57	.98	.86
TP vs TIP	.97	.98	.96	.98
TP vs DP	.33	.89	.04	.29
DP vs DIP	.99	.99	.996	.97
DP vs OP	.99	.99	.99	.96
TP vs TN	.51	.89	.59	.50
DP vs DN	.84	.92	.55	.79
OP vs NIT	.71	.74	.38	.84
TN vs DN	.94	.97	.74	.92
DN vs NIT	.91	.87	.94	.96

ABLE: A-8 PEARSON'S CORRELATION BETWEEN MEAN DAILY DISCHARGE AND SELECTED WATER CHEMISTRY VARIABLES

DATA SET	PP	DP	PN	DN	POC	TURB	NFR
ALL	.46	-.21	.38	-.14	.49	.53	.59
Oldman R.	.63	-.21	.71	-.01	.75	.70	.68
S. Sask. R.	.58	-.20	.32	-.20	.36	.68	.82
Bow R.	.18	-.30	.05	-.29	.18	.57	.44
Site 3	.63	.28	.64	.23	.65	.74	.67
Site 4	.69	-.44	.81	-.05	.87	.72	.73
Site 8	.77	-.18	.69	-.08	.79	.89	.91
Site 9	.52	-.22	.31	-.19	.37	.83	.79
Site 10	.32	-.21	.24	-.21	.23	.60	.76
Site 11	.53	-.21	.42	-.23	.53	.74	.88
Site 12	.95	-.18	.50	-.16	.62	.86	.92
Site 1	.09	.05	-.11	-.04	.42	.48	.58
Site 2	-.18	-.75	-.20	-.70	.03	.70	.42
Site 5	.35	-.64	.09	-.64	.30	.59	.50
Site 6	.23	-.48	.24	-.38	.18	.56	.34
Site 13	.31	-.25	.17	-.23	.27	.74	.71
Site 7	.43	-.19	.13	-.21	.26	.74	.69

TABLE: A-9

COMPARISON OF PHOSPHORUS LOADING VALUES USING STUDY AND FEDERAL DATA

Site	Phosphorus Loading (tonnes) Study (1)	Federal (2)	Combined (3)	Coefficient of Variation 1 vs 2	1 vs 3
TP					
#1 - 1980	21.8	23.6	22.4	6	2
1981	29.4	20.2	25.8	26	9
#7 - 1980	389.0	459.2	413.8	12	4
1981	419.6	623.2	497.4	28	12
#3 - 1980	155.7	62.4	122.0	60	17
1981	762.8	253.4	580.6	71	19
#8 - 1980	149.6	149.8	129.0	0	10
1981	828.0	648.0	760.5	17	6
#12 - 1980	510.4	761.0	598.2	28	11
1981	499.6	782.1	598.5	31	13
DP					
#1 - 1980	8.4	11.4	9.4	21	8
1981	11.4	8.0	10.1	25	9
#7 - 1980	161.6	179.6	167.9	7	3
1981	214.2	191.8	205.6	8	3
#3 - 1980	10.4	7.6	9.5	22	6
1981	34.2	12.2	26.4	67	18
#8 - 1980	38.0	61.0	41.0	33	5
1981	50.9	45.0	48.6	9	3
#12 - 1980	147.8	174.2	156.1	12	4
1981	157.4	96.8	138.2	34	9

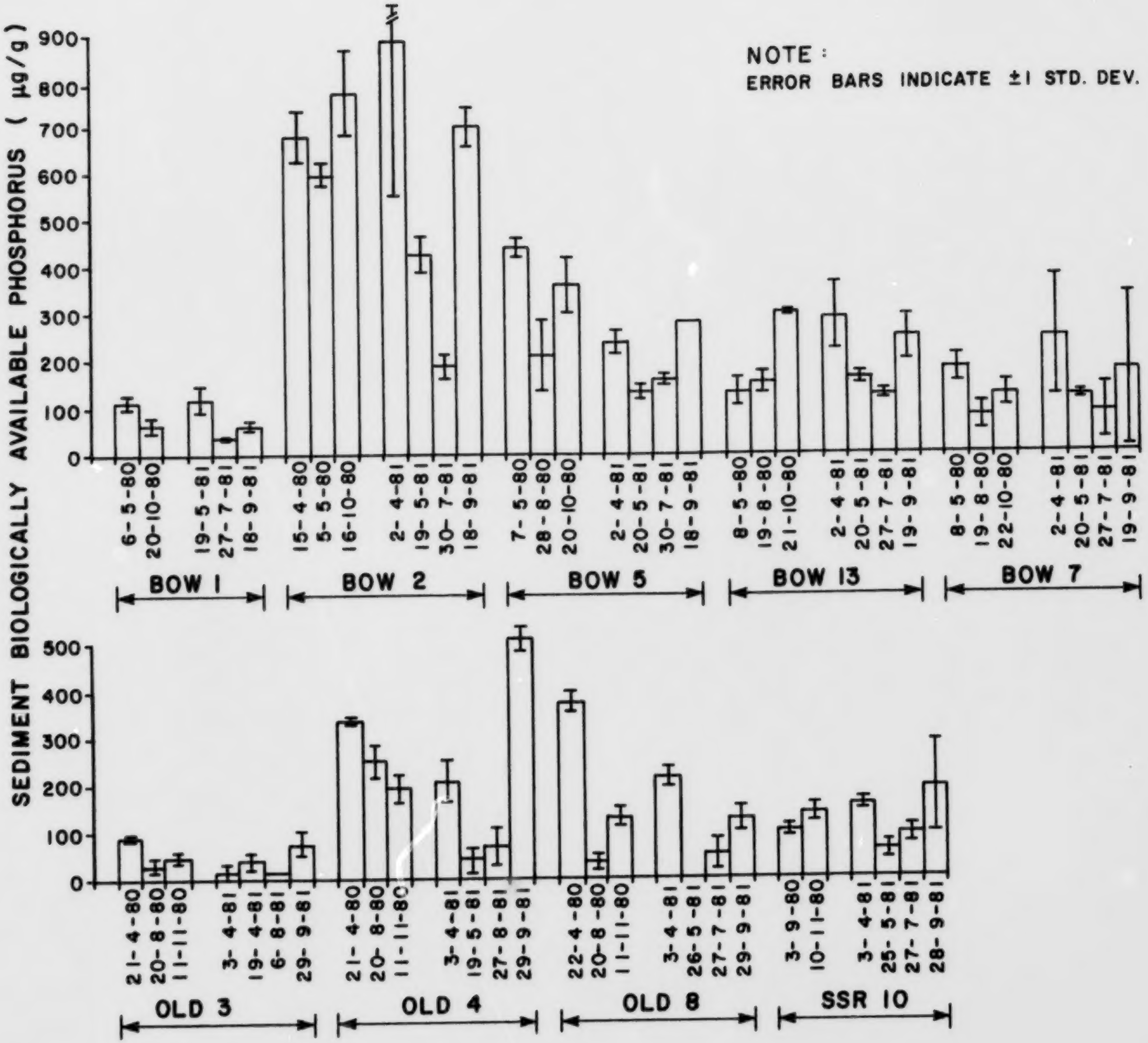

Figure A-2: Seasonal distribution of SBAP at selected study sites, 1980-81.

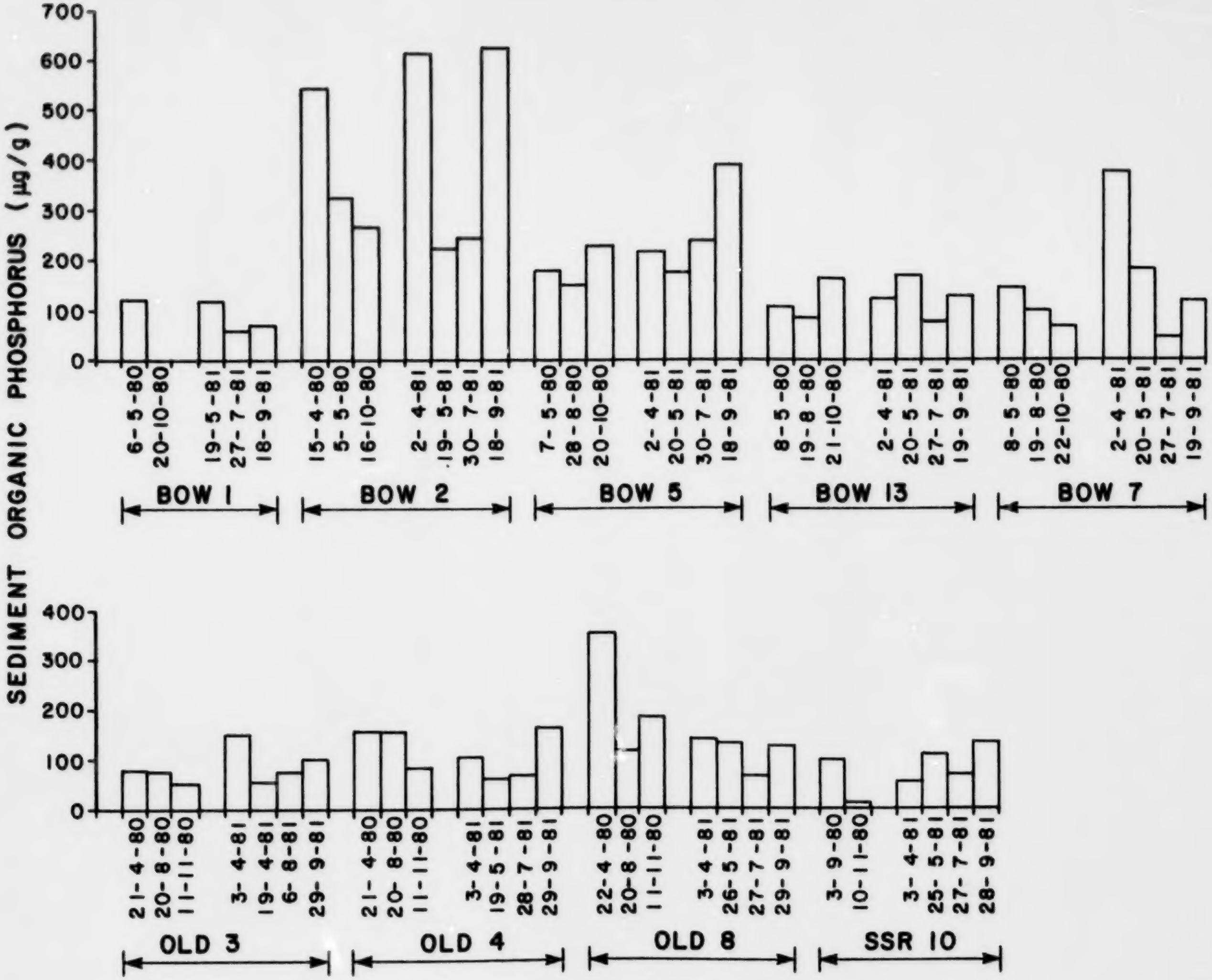

Figure A-3 Seasonal distribution of ORGP at selected study sites, 1980-81.

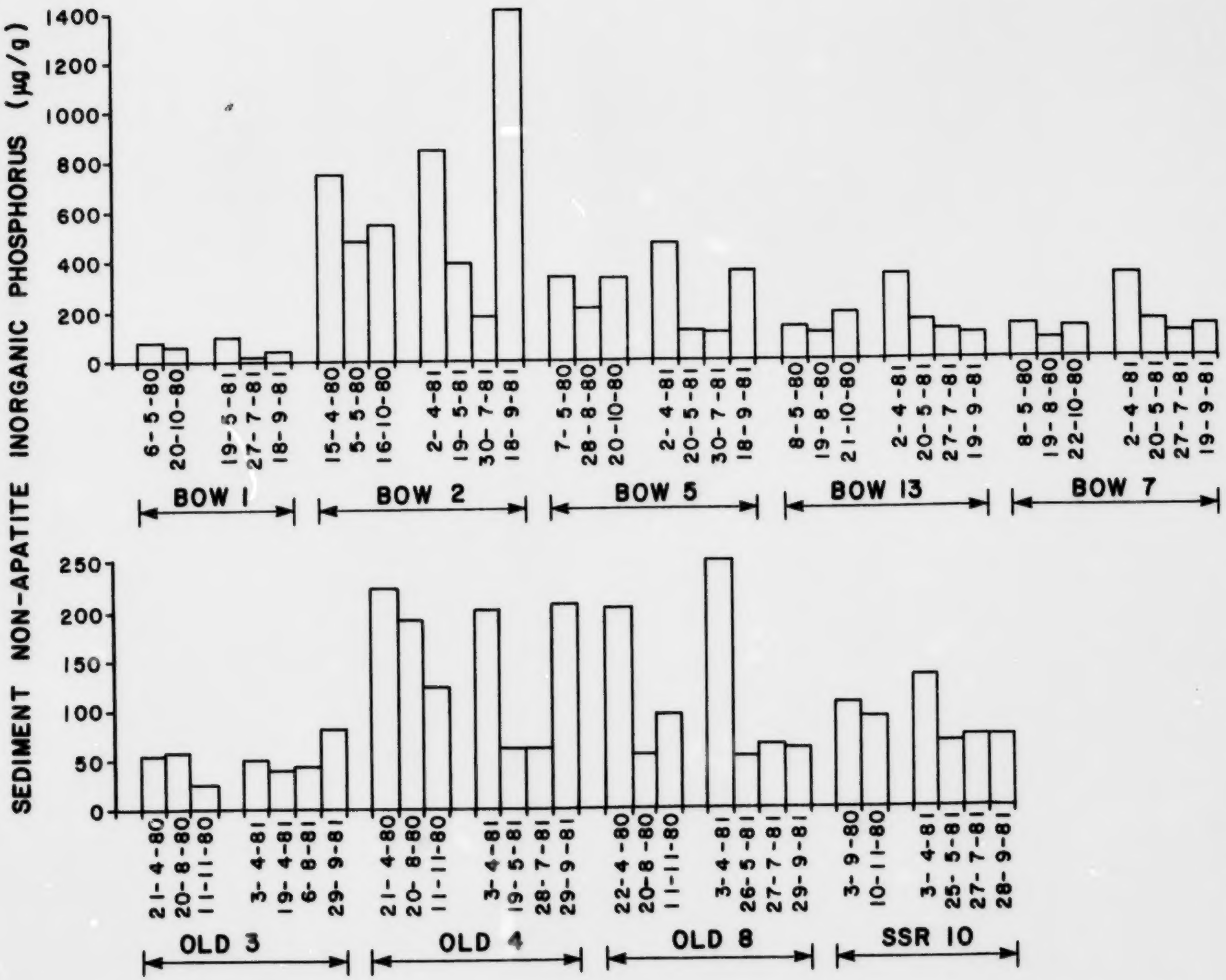

Figure A-4 Seasonal distribution of NAIP at selected study sites, 1980-81.

The Limnological Characteristics of the Bow, Oldman and South Saskatchewan Rivers (1979)

Part I – Appendix

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THE LIMNOLOGICAL CHARACTERISTICS OF THE BOW, OLDMAN AND SOUTH SASKATCHEWAN RIVERS (1979 - 82)

PART I

NUTRIENT AND WATER CHEMISTRY

APPENDIX 'B'

Prepared by:

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March 1986

B-1 NAQUADAT printout of routine, precision and diurnal variability study data

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          PAGE   1                                   NAQUADAT DETAILED REPORT
                                                   PHOSPHORUS AND NITROGEN FORMS

     STATION 00AT05BH2090    LAT. 51D  5M  9S  LONG. 114D 17M 21S   PR 4   UTM 11 689900E 5662700N
     BOW RIVER   BELOW BEARSPAW DAM

                                   15406L      15301L      15103F      15356F      15256F      07661F      07110F      07506L
                                PHOSPHOROUS  PHOSPHORUS  PHOSPHORUS  PHOSPHORUS  PHOSPHORUS   NITROGEN    NITROGEN    NITROGEN
                                   TOTAL       TOTAL      DISSOLVED   DISSOLVED   DISSOLVED   DISSOLVED   DISSOLVED     TOTAL
       SAMPLE DATE               PHOSPHATE   INORGANIC               INORG. PO4  ORTHO PO4       N        NO3 & NO2    AMMONIA
           MST          SUBM         P           P           P           P           P                        N           N
      D  M  Y  HR        ID        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L

     10 03 80 0825      0426       .009        .003      .004 13L    L.003 46L   L.003 66L    .10 61L     .08 19L      L.1
     10 03 80 0830      0426       .008        .004      .003 03L    L.003 56L   L.003 56L    .11 51L     .09 10L      L.1
     24 03 80 1540      0426       .005        .003      .003 13L    L.003 46L   L.003 66L    .13 61L     .06 19L      L.1
     24 03 80 1545      0426       .006        .004      .004 03L    L.003 56L   L.003 56L    .13 51L     .07 10L      L.1
     08 04 80 1135      0426       .011        .005     L.003 13L    L.003 46L   L.003 66L    .13 61L     .06 19L      L.1

     08 04 80 1140      0426       .013        .012      .004 03L    L.003 56L   L.003 56L    .10 51L     .06 10L      L.1
     21 04 80 1225      0426       .008       L.003     L.003 13L    L.003 46L   L.003 66L    .08 61L     .03 19L      L.1
     21 04 80 1230      0426       .011        .008     L.003 03L    L.003 56L   L.003 56L    .08 51L     .02 10L      L.1
     05 05 80 0605      0426                  L.003     L.003 13F    L.003 46F   L.003 66F    .10         .02 19F      L.1
     05 05 80 0610      0426       .007        .006                  L.003       L.003        .10 51F     .02          L.1

     20 05 80 0555      0426       .012                 L.003 13F    L.003 46F   L.003 66F    .11         .04 19F      L.1
     20 05 80 0600      0426       .010                  .003        L.003       L.003        .09 51F     .03          L.1
     02 06 80 0700      0426       .013        .004      .004 03L    L.003 56L    .004 56L    .18 51L     .06 10L      L.1
     02 06 80 0701      0426       .018        .003     L.003 03L    L.003 56L   L.003 56L    .15 51L     .06 10L      L.1
     02 06 80 0702      0426       .008        .003     L.003 03L    L.003 56L   L.003 56L    .16 51L     .05 10L      L.1

     02 06 80 0703      0426       .008        .004     L.003 03L    L.003 56L   L.003 56L    .17 51L     .05 10L      L.1
     02 06 80 1245      0426       .007        .007      .005 03L    L.003 56L   L.003 56L    .14 61L     .05 10L      L.1
     02 06 80 1330      0426       .005                  .005                    L.003        .12 51F
     02 06 80 1345      0426       .004                  .003                    L.003        .10 51F
     02 06 80 1430      0426       .004                  .003                    L.003        .11 51F

     02 06 80 1530      0426       .006                  .003                    L.003        .11 51F
     02 06 80 1730      0426       .006                  .003                    L.003        .11 51F
     02 06 80 2130      0426       .018                  .003                    L.003        .11 51F
     03 06 80 0130      0426       .012                  .003                    L.003        .11 51F
     03 06 80 0530      0426       .008                  .003                    L.003        .11 51F

     03 06 80 0930      0426       .008                  .003                    L.003        .10 51F
     03 06 80 1100      0426       .011        .003     L.003 03L    L.003 56L   L.003 56L    .11 51L    L.01 10L      L.1
     03 06 80 1101      0426       .008        .003     L.003 03L    L.003 56L   L.003 56L    .11 51L     .05 10L      L.1
     03 06 80 1102      0426       .003        .003     L.003 03L    L.003 56L   L.003 56L    .12 51L     .07 10L      L.1
     03 06 80 1103      0426       .003        .003      .003 03L    L.003 56L   L.003 56L    .12 51L     .07 10L      L.1

     03 06 80 1104      0426       .003       L.003      .004 03L    L.003 56L   L.003 56L    .12 51L     .07 10L      L.1
     03 06 80 1330      0426       .014                  .003                    L.003        .10 51F
     16 06 80 0715      0426       .013        .004     L.003        L.003       L.003        .12         .05          L.1
     01 07 80 0700      0426       .009       L.003      .009        L.003       L.003        .12         .04          L.1
     14 07 80 1400      0426       .006        .003      .003        L.003       L.003        .08         .02          L.1

     28 07 80 0700      0426       .005        .005      .003         .003       L.003        .06         .02          L.1
     11 08 80 0700      0426       .006                  .003                    L.003        .03 51F
     11 08 80 0730      0426       .017        .004      .003        L.003       L.003        .05         .01          L.1
     11 08 80 1100      0426       .009                  .003                    L.003        .04 51F
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NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
11 08 80 1530	0426	.004		L.003		L.003	.04 51F		
11 08 80 1545	0426	.007		L.003		L.003	.04 51F		
11 08 80 1630	0426	.006		L.003		L.003	.04 51F		
11 08 80 1730	0426	.019		L.003		L.003	.04 51F		
11 08 80 1900	0426	.010		L.003		L.003	.04 51F		
11 08 80 2300	0426	.011		L.003		L.003	.04 51F		
12 08 80 0300	0426	.009		L.003		L.003	.03 51F		
12 08 80 0700	0426	.007		L.003		L.003	.04 51F		
25 08 80 0700	0426	.006	L.003	L.003	L.003	L.003	.09	.02	L.1
08 09 80 0800	0426	.003		L.003	L.003	L.003	.07	.02	L.1
09 09 80 1100	0426	.003							
09 09 80 1101	0426	.003							
09 09 80 1102	0426	.006							
09 09 80 1103	0426	.004							
12 09 80 0900	0426	L.003							
12 09 80 0901	0426	L.003							
12 09 80 0902	0426	L.003							
12 09 80 0903	0426	.003							
12 09 80 0904	0426	L.003							
22 09 80 0730	0426	.009	L.003	.003	L.003	L.003	.08	.02	L.1
06 10 80 0700	0426	.009	L.003		L.003	L.003	.05	.01	L.1
20 10 80 0830	0426	L.003	L.003	L.003	L.003	L.003	.07	.01	L.1
03 11 80 0915	0426	L.003	L.003	L.003	L.003	L.003	.08	.03	L.1
03 11 80 0917	0426	.003	L.003	L.003	L.003	L.003		.03	L.1
18 11 80 0800	0426	.004		.004	.004	L.003	.08	.04	L.1
08 12 80 1320	0426	.003	.003	.003	L.003	L.003	.10	.07	L.1
05 01 81 0800	0426	L.003	L.003	L.003	L.003	L.003	.15	.08	L.1
26 01 81 0830	0426	.003	.003	.003	L.003	L.003	.09	.08	L.1
16 02 81 0800	0426	.017		L.003		L.003	.12	.06	L.1
09 03 81 0800	0426	L.003	L.003	L.003	L.003	L.003	.32	.16	L.1
20 03 81 0900	0426	.010	.008	.008	.008	L.003	.13	.03	L.1
06 04 81 0900	0426	.008	.005	L.003	L.003	L.003	.23	.03	L.1
21 04 81 0800	0426	.007	.006		L.003	L.003	.23	.01	L.1
04 05 81 0800	0426	.018	L.003	L.003	L.003	L.003	.05	L.01	L.1
19 05 81 0915	0426	.009	.006	.005	L.003	L.003	.21	.03	L.1
01 06 81 0900	0426	.018	.018	.005	L.003	L.003	.17		L.1
01 06 81 0905	0426	.023	.023	L.003	L.003	L.003	.17		L.1
01 06 81 0915	0426	.020	.012	L.003	L.003	L.003	.32		L.1
01 06 81 0920	0426	.018	.013	L.003	L.003	L.003	.15		L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
01 06 81 0930	0426	.019	.011	L.003	L.003	L.003	.16	.09	L.1
09 06 81 0830	0426	.014	.007	L.003	L.003	L.003	.14	.08	L.1
30 06 81 0800	0426	.006	L.003	L.003	L.003	L.003	.08	.03	L.1
20 07 81 0845	0426	.013	.011	.008	.008	L.003	.10	.05	L.1
20 07 81 0850	0426	.013	.011	.003	.003	L.003	.10	.06	L.1
08 08 81 1745	0426	.006	.005	L.003	L.003	L.003	.12	.04	L.1
24 08 81 1030	0426	.005	L.003	L.003	L.003	L.003	.07	.03	L.1
21 09 81 1400	0426	L.003	L.003	L.003	L.003	L.003	.08	.02	L.1
15 10 81 1030	0426	L.003	L.003	L.003	L.003	L.003	.08	.03	L.1
02 11 81 0840	0426	.013		.010	.005	L.003		.03	.2
23 11 81 0830	0426	.003	L.003	L.003	L.003	L.003	.10	.06	.1
14 12 81 0800	0426	L.003	L.003	L.003	L.003	L.003	.15	.08	L.1
08 01 82 0800	0426	.017	.013	.010	.008	.008	.17	.10	L.1
01 02 82 1630	0426	.005	L.003	.003	L.003	L.003	.16	.11	L.1
24 02 82 0830	0426	L.003	L.003	L.003	L.003	L.003	.14	.11	L.1
15 03 82 0830	0426	.007	.006	.003	.003	L.003	.17	.11	L.1
05 04 82 1015	0426	.005	.003	.004	L.003	L.003	.15	.12	L.1
28 04 82 0900	0426	.008	.008	L.003	L.003	L.003	.12	.06	L.1

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
10 03 80 0825	0426	0.	.5	L1.	L1.	.01 02L	.11 02L	2. 06L
10 03 80 0830	0426	0.	.8	L1.	L1.			L1. 04L
24 03 80 1540	0426	0.	1.1	4.	2.	.04 02L	.14 02L	1. 06L
24 03 80 1545	0426	0.	1.5	2.	2.			1. 04L
08 04 80 1135	0426	1. 61F	1.0	L1.	L1.	L.01 02L	.21 02L	2. 06L
08 04 80 1140	0426	1. 61F	4.3	L1.	L1.			1. 04L
21 04 80 1225	0426	5. 61F	.2	1.	L1.	.06 02L	.24 02L	1. 06L
21 04 80 1230	0426	5. 61F	.3	L1.	L1.			2. 04L
05 05 80 0605	0426	9. 61F	2.8	2.	L1.	.08	.41	1. 06F
05 05 80 0610	0426	9. 61F	2.6	4.	2.			2.
20 05 80 0555	0426	12. 61F	2.5	2.	2.	.06	.29	2. 06F

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
20 05 80 0600	0426	12. 61F	2.2	L1.	L1.			2.
02 06 80 0700	0426			3.0	2.0	.03 02L	.20 02L	2. 04L
02 06 80 0701	0426			3.0	3.0	.04 02L	.20 02L	2. 04L
02 06 80 0702	0426			5.0	5.0	L.01 02L	.22 02L	2. 04L
02 06 80 0703	0426			5.0	4.0	.04 02L	.20 02L	2. 04L
02 06 80 1245	0426	12. 61F	3.3	3.0	3.0	.03 02L	.13 02L	2. 04L
02 06 80 1330	0426	11.0 61F						
02 06 80 1345	0426	11.0 61F						
02 06 80 1430	0426	10.8 61F						
02 06 80 1530	0426	10.8 61F						
02 06 80 1730	0426	10.5 61F						
03 06 80 0930	0426	9.8 61F						
03 06 80 1100	0426			4.	4.	.04 02L	.29 02L	2. 04L
03 06 80 1101	0426			4.	4.	.05 02L	.29 02L	2. 04L
03 06 80 1102	0426			3.	3.	.05 02L	.24 02L	2. 04L
03 06 80 1103	0426			4.	4.	.04 02L	.30 02L	2. 04L
03 06 80 1104	0426			4.	3.	.04 02L	.26 02L	2. 04L
03 06 80 1330	0426	9.5 61F						
16 06 80 0715	0426	15. 61F	2.3	6.0	5.0	.06	.32	2.
01 07 80 0700	0426	11. 61F	1.7	L1.	L1.	.05	.18	1.
14 07 80 1400	0426		1.5	1.	L1.	.04	.19	2.
28 07 80 0700	0426	16.0 61F	1.3	L1.	L1.	.04	.17	1.
11 08 80 0700	0426	15.5 61F						
11 08 80 0730	0426	14.0 61F	2.7	5.	5.	.09	.26	1.
11 08 80 1100	0426	15.5 61F						
11 08 80 1530	0426	15.3 61F						
11 08 80 1545	0426	15.4 61F						
11 08 80 1630	0426	15.4 61F						
11 08 80 1730	0426	15.3 61F						
11 08 80 1900	0426	15.2 61F						
11 08 80 2300	0426	15.0 61F						
12 08 80 0300	0426	14.7 61F						
12 08 80 0700	0426	14.5 61F						
25 08 80 0700	0426	13. 61F	2.3	1.	L1.	.09	.17	L1.
08 09 80 0800	0426	13. 61F	1.6	3.	2.	.04	.19	L1.
22 09 80 0730	0426	10. 61F	1.0	1.	L1.	.03	.11	1.
06 10 80 0700	0426	11. 61F	1.0	1.	L1.	.02	.17	1.
20 10 80 0830	0426	8. 61F	3.7	3.	1.	.04	.17	2.
03 11 80 0915	0426	0. 61F	1.	L1.	L1.	.06	.22	L1.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
03 11 80 0917	0426	0. 61F	.8	L1.	L1.	.05	.22	1.
18 11 80 0800	0426		1.5	1.	L1.	.03	.10	L1.
08 12 80 1320	0426	.0 61F	1.2	2.	2.	L.01	.05	1.
05 01 81 0800	0426	0. 61F	1.2	L1.	L1.	.05	.19	1.
26 01 81 0830	0426		3.2	4.	2.	.04	.21	1.
16 02 81 0800	0426		1.3	2.	L1.	.01	.11	1.
09 03 81 0800	0426		1.	1.	L1.	.05	.20	1.
20 03 81 0900	0426		1.1	L1.	L1.	.04	.27	1.
06 04 81 0900	0426	3.0 61F	1.2	1.	L1.	.06	.06	1.
21 04 81 0800	0426	6.0 61F	1.5	4.	2.	.10	.28	2.
04 05 81 0800	0426	8.0 61F	2.6	3.	2.	.07	.39	2.
19 05 81 0915	0426	9.0 61F	14.	13.	12.	.09	.40	3.
01 06 81 0900	0426	9.0 61F		27.	24.	.06	.65	3.
01 06 81 0905	0426	9.0 61F		27.	24.	.05	.54	2.
01 06 81 0915	0426	9.0 61F		26.	23.	.05	.46	2.
01 06 81 0920	0426	9.0 61F		23.	21.	.05	.52	2.
01 06 81 0930	0426	9.0 61F		26.	23.	.05	.51	2.
09 06 81 0830	0426	9.0 61F	11.	8.	6.	L.01	.29	3.
30 06 81 0800	0426	12.0 61F	2.5	1.	L1.	.03	.22	2.
20 07 81 0845	0426	13. 61F	7.5	9.		.04	.36	2.
20 07 81 0850	0426	13. 61F	15.	9.		.04	.27	2.
08 08 81 1745	0426	13. 61F	3.9	2.	L1.	.04	.25	3.
24 08 81 1030	0426	16. 61F	2.5	4.	2.	.03	.17	1.
21 09 81 1400	0426	13. 61F	1.4	2.	1.	.03	.15	1.
15 10 81 1030	0426	7. 61F	1.3	L1.	L1.	.04	.16	2.
02 11 81 0840	0426	6. 61F	.9	1.	1.	.04	.20	2.
23 11 81 0830	0426	2.0 61F	1.5	1.	L1.	.02	.09	2.
14 12 81 0800	0426	.0 61F	2.0	2.0	L1.	.03	.10	2.
08 01 82 0800	0426	.0 61F	1.2	1.	L1.	L.01	.11	2.
01 02 82 1630	0426	.0 61F	1.1	1.	L1.	.02	.04	2.
24 02 82 0830	0426	.0 61F	.8	L1.	L1.	.02		2.
15 03 82 0830	0426	5.0 61F	.8	L1.	L1.	.02	.08	1.
05 04 82 1015	0426	5.0 61F	.5	L1.	L1.	L.01	.10	1.
28 04 82 0900	0426	.0 61F	1.6	1.	L1.	.06	.32	1.

NAQUADAT DETAILED REPORT

PH DIC ALK COND CL SIO2

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
10 03 80 0825	0426	8.0	23. 53L	120.	.0	343.		4.4
10 03 80 0830	0426	8.0	24. 52L	120.	.0	356.		4.3
24 03 80 1540	0426	8.2	22. 53L	110.	.0	365.		4.0
24 03 80 1545	0426	8.1	19. 52L	100.	.0	367.		4.2
08 04 80 1135	0426	8.2	20. 53L	120. 01L	.0	312.	1.2	4.0
08 04 80 1140	0426	8.3	21. 52L	120. 01L	.0	343.	1.2	3.9
21 04 80 1225	0426	8.3	25. 53L	120. 01L	.0	323.	1.2	3.7
21 04 80 1230	0426	8.2	26. 52L	120. 01L	0.	327.	1.2	3.7
05 05 80 0605	0426	8.2	22. 53F	110. 01L	0.	293.	1.2	3.4
05 05 80 0610	0426	8.2	23.	110. 01L	0.	304.	1.1	3.3
20 05 80 0555	0426	8.2	21. 53F	101. 01L	0.	272.	.8	3.6
20 05 80 0600	0426	8.2	20.	101. 01L	0.	271.	.8	3.4
02 06 80 0700	0426	8.2	21. 52L	103. 01L	.0	266.	1.0	4.0
02 06 80 0701	0426	8.2	21. 52L	102. 01L	.0	270.	.9	4.0
02 06 80 0702	0426	8.2	21. 52L	102. 01L	.0	269.	.9	4.0
02 06 80 0703	0426	8.2	21. 52L	100. 01L	.0	268.	.9	4.2
02 06 80 1245	0426	8.3	21. 52L	104. 01L	.0	270.	.9	3.6
02 06 80 1330	0426	8.3				267.		
02 06 80 1345	0426	8.3				267.		
02 06 80 1430	0426	8.3				267.		
02 06 80 1530	0426	8.3				267.		
02 06 80 1730	0426	8.3				267.		
02 06 80 2130	0426	8.2				267.		
03 06 80 0130	0426	8.2				267.		
03 06 80 0530	0426	8.3				267.		
03 06 80 0930	0426	8.3				266.		
03 06 80 1100	0426	8.5	20. 52L	114. 01L	.2	256.	1.0	4.2
03 06 80 1101	0426	8.5	22. 52L	102. 01L	1.0	258.	.9	3.8
03 06 80 1102	0426	8.5	22. 52L	103. 01L	.7	254.	.9	3.8
03 06 80 1103	0426	8.5	21. 52L	103. 01L	.5	255.	.9	3.8
03 06 80 1104	0426	8.5	21. 52L	105. 01L		258.	.9	3.8
03 06 80 1330	0426	8.2				267.		
16 06 80 0715	0426	8.2	22.	108. 01L	.0	285.	.9	4.0
01 07 80 0700	0426	8.3	22.	106. 01L	.0	276.	.8	3.6
14 07 80 1400	0426	8.3	22.	108. 01L	.0	281.	.9	3.5
28 07 80 0700	0426	8.4	22.	106. 01L	1.0	286.	.9	3.0
11 08 80 0730	0426	8.4	21.	106. 01L	.0	281.	.9	3.2
25 08 80 0700	0426	8.1	22.	107. 01L	.0	291.	.9	3.7
08 09 80 0800	0426	8.3	23.	111. 01L	.0	302.	1.0	3.5

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
09 09 80 1100	0426	8.3		111. 01L	.0	303.	1.0	3.5
09 09 80 1101	0426	8.3		111. 01L	.0	303.	1.0	3.7
09 09 80 1102	0426	8.3		111. 01L	.0	301.	1.0	3.5
09 09 80 1103	0426	8.3		111. 01L	.0	306.	1.0	3.7
12 09 80 0900	0426	8.3		114. 01L	.0	307.	1.0	3.7
12 09 80 0901	0426	8.2		113. 01L	.0	306.	1.0	3.7
12 09 80 0902	0426	8.2		114. 01L	.0	308.	1.0	3.7
12 09 80 0903	0426	8.2		112. 01L	.0	307.	1.0	3.7
12 09 80 0904	0426	8.2		115. 01L	.0	307.	1.0	3.7
22 09 80 0730	0426	8.3	27.	117. 01L	.0	310.	.9	3.5
06 10 80 0700	0426	8.4	26.	115. 01L	.0	312.	1.1	3.4
20 10 80 0830	0426	8.4	27.	118. 01L	.0	316.	1.2	3.4
03 11 80 0915	0426	8.3	31.	121. 01L	.0	327.	1.2	3.4
03 11 80 0917	0426	8.3	32.	119. 01L	.0	337.	1.1	3.5
18 11 80 0800	0426	8.2	29.	124. 01L	.0	333.	1.2	3.6
08 12 80 1320	0426	8.2	27.	132. 01L	.0	355.	1.1	4.0
05 01 81 0800	0426	8.1	23.	125. 01L	.0	353.	1.2	4.1
26 01 81 0830	0426		33.	122. 01L	.0	338.	1.1	4.0
16 02 81 0800	0426	8.1	31.	121. 01L	.0	337.	1.1	3.6
09 03 81 0800	0426	8.2	34.	121. 01L	.0	334.	1.0	3.5
20 03 81 0900	0426	8.3	39.	122. 01L	.0	342.	.9	3.6
06 04 81 0900	0426	8.3	29.	121. 01L	.0	339.	.9	3.6
21 04 81 0800	0426	8.3	28.	122. 01L	.0	346.	.9	3.4
04 05 81 0800	0426	8.3	31.	123. 01L	.0	341.	1.1	3.5
19 05 81 0915	0426	8.3	31.	129. 01L	.0	338.	1.5	4.8
01 06 81 0900	0426	8.1	25.	109. 01L	.0	269.	.9	4.3
01 06 81 0905	0426	8.1	25.	109. 01L	.0	268.	.9	4.3
01 06 81 0915	0426	8.1	25.	109. 01L	.0	269.	.9	4.3
01 06 81 0920	0426	8.1	25.	109. 01L	.0	264.	.9	4.3
01 06 81 0930	0426	8.1	25.	108. 01L	.0	271.	.9	4.3
09 06 81 0830	0426	8.2	26.	110. 01L	.0	279.	1.1	4.5
30 06 81 0800	0426	8.4	26.	122. 01L	2.3	305.	1.2	4.0
20 07 81 0845	0426	8.3	27.	109. 01L	.0	269.	.9	3.7
20 07 81 0850	0426	8.3	29.	110. 01L	.0	269.	.9	3.6
08 08 81 1745	0426	8.2	27.	114. 01L	.0	281.	.9	4.2
24 08 81 1030	0426	8.3	28.	113. 01L	.0	285.	.9	3.7
21 09 81 1400	0426	8.4	27.	119. 01L	.0	293.	1.0	3.0
15 10 81 1030	0426	8.2	30.	125. 01L	.0	312.	1.2	3.2
02 11 81 0840	0426	8.3	30.	127. 01L	.0	328.	1.4	3.0

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BH2090 LAT. 51D 5M 9S LONG. 114D 17M 21S PR 4 UTM 11 689900E 5662700N
BOW RIVER BELOW BEARSPAW DAM

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
23	11	81	0830	0426	8.1	23.	133. 01L	.0	332.	1.4	3.6
14	12	81	0800	0426	8.1	33.	137. 01L	.0	338.	1.4	4.0
08	01	82	0800	0426	8.1	32.	143. 01L	.0	355.	1.3	4.2
01	02	82	1630	0426	8.1	29.	135. 01L	.0	338.	1.3	4.1
24	02	82	0830	0426	8.2	36.	135. 01L	.0	334.	1.3	4.3
15	03	82	0830	0426	8.1	31.	130. 01L	.0	326.	1.2	3.8
05	04	82	1015	0426	8.1	32.	130. 01L	.0	321.	1.4	3.8
28	04	82	0900	0426	8.2	22.	120. 01L	.0	295.	1.5	3.7

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BH2105 LAT. 51D 6M 0S LONG. 114D 12M 36S PR 3 UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
14 05 79 1010	0426	.004	L.003	L.003 13F	L.003 46F	L.003 66F	.07	.01 19F	L.1
14 05 79 1015	0426	.003	.005	L.003	L.003	L.003	.07 51F	.01	L.1
28 05 79 0805	0426	.009	.006	.003 13F		L.003 66F	.07	.02 19F	L.1
28 05 79 0840	0426	.008	.006	L.003	L.003	L.003	.07 51F	.02	L.1
11 06 79 0735	0426	.007	.007	L.003 13F	.005 46F	L.003 66F	.22	.13 19F	L.1
11 06 79 0800	0426	.005	L.003	L.003	L.003	L.003	.17 51F	.08	L.1
25 06 79 0835	0426	.009	.006	.008 13F	L.003 46F	L.003 66F	.11	.05 19F	L.1
25 06 79 0855	0426	.014	.005	.004	L.003	L.003	.09 51F	.04	L.1
09 07 79 1210	0426	.007	L.003	L.003 13F	L.003 46F	L.003 66F	.13	.05 19F	L.1
09 07 79 1230	0426	.008	.004	L.003	L.003	L.003	.09 51F	.04	L.1
23 07 79 1245	0426	.005	L.003	.004 13F	L.003 46F	L.003 66F	.06	.02 19F	L.1
23 07 79 1300	0426	.006	.004	.004	.004	L.003	.10 51F	.04	L.1
05 08 79 0705	0426	.012	.012	.003 13F	L.003 46F	L.003 66F	.06	.03 19F	L.1
05 08 79 0720	0426	.007	.004	L.003	L.003	L.003			L.1
20 08 79 1130	0426	L.003	L.003	L.003 13F	L.003 46F	L.003 66F	.16	.03 19F	L.1
20 08 79 1145	0426	.006	.004	.004	L.003	L.003	.10 51F	.03	L.1
23 09 79 1230	0426	.008	L.003	.003 13F	L.003 46F	L.003 66F			L.1
23 09 79 1235	0426	.008	.003	.006	L.003	L.003	.05 51F	.02	L.1
08 10 79 1125	0426	.005	L.003	L.003 13F	L.003 46F	L.003 66F	.17	.01 19F	L.1
08 10 79 1130	0426	.010	L.003	L.003	L.003	L.003	.17 51F	.02	L.1
28 10 79 1455	0426	.004	.004	L.003 13F	L.003 46F	L.003 66F	.12	.01 19F	L.1
28 10 79 1500	0426	.004	.004	L.003	L.003	L.003	.06 51F	.01	L.1
18 11 79 1255	0426	L.003	L.003	L.003 13L	L.003 46L	L.003 66L	.07 61L	.03 19L	L.1
18 11 79 1300	0426	.006	L.003	.004 03L	L.003 56L	L.003 56L	.09 51L	.03 10L	L.1
09 12 79 1640	0426	.003		.003 13L		L.003 66L	.10 61L	.06 19L	L.1
09 12 79 1645	0426	L.003	L.003	L.003 03L	L.003 56L	L.003 56L	.12 51L	.07 10L	L.1
07 01 80 1425	0426	.010		L.003 13L	L.003 46L	L.003 66L	.14 61L	.11 19L	L.1
07 01 80 1430	0426	.018	.015	.004 03L	L.003 56L	L.003 56L	.14 51L	.12 10L	L.1
28 01 80 1140	0426	.008	L.003	.003 13L	L.003 46L	L.003 66L	.18 61L	.09 19L	L.1
28 01 80 1145	0426	.012	.005	.011 03L	L.003 56L	L.003 56L	.15 51L	.09 10L	L.1
18 02 80 1210	0426	.004	.003	L.003 13L	L.003 46L	L.003 66L	.15 61L	.08 19L	L.1
18 02 80 1215	0426	.006	.003	L.003 03L	L.003 56L	L.003 56L	.13 51L	.08 10L	L.1
27 10 80 0815	0426	L.003		L.003		L.003	.05 51F	.02	
27 10 80 1200	0426	L.003		L.003		L.003	.06 51F	.02	
27 10 80 1600	0426	L.003		L.003		L.003	.05 51F	.02	
27 10 80 1615	0426	L.003		L.003		L.003	.05 51F	.02	
27 10 80 1700	0426	L.003		L.003		L.003	.06 51F	.02	
27 10 80 1800	0426	L.003		L.003		L.003	.04 51F	.02	
27 10 80 2000	0426	.005		L.003		L.003	.05 51F	.02	

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                              NAQUADAT DETAILED REPORT
                            PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BH2105    LAT. 51D  6M  0S  LONG. 114D 12M 36S   PR 3   UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

                       15406L        15301L         15103F        15356F        15256F        07661F        07110F        07506L
                     PHOSPHOROUS   PHOSPHORUS     PHOSPHORUS    PHOSPHORUS    PHOSPHORUS     NITROGEN      NITROGEN      NITROGEN
                        TOTAL         TOTAL       DISSOLVED     DISSOLVED     DISSOLVED      DISSOLVED     DISSOLVED       TOTAL
  SAMPLE DATE         PHOSPHATE     INORGANIC                   INORG. PO4    ORTHO PO4          N         NO3 & NO2      AMMONIA
      MST      SUBM       P             P              P             P             P                           N             N
 D  M  Y  HR    ID      MG/L          MG/L           MG/L          MG/L          MG/L          MG/L          MG/L          MG/L

28 10 80 0000  0426    L.003                        L.003                        L.003          .05 51F      .03
28 10 80 0400  0426    L.003                        L.003                        L.003          .05 51F      .02
28 10 80 0800  0426    L.003                        L.003                        L.003          .06 51F      .02
05 01 81 0800  0426     .013                         .008                        L.003          .12 51F
05 01 81 1200  0426     .012                         .003                        L.003          .13 51F

05 01 81 1600  0426     .007                        L.003                        L.003          .12 51F
05 01 81 1615  0426     .006                        L.003                        L.003          .12 51F
05 01 81 1700  0426     .006                        L.003                        L.003          .12 51F
05 01 81 1800  0426     .004                        L.003                        L.003          .12 51F
05 01 81 2000  0426     .004                        L.003                        L.003          .12 51F

06 01 81 0000  0426     .007                        L.003                        L.003          .12 51F
06 01 81 0400  0426     .003                        L.003                        L.003          .12 51F
06 01 81 0800  0426    L.003                        L.003                        L.003          .12 51F
23 03 81 0800  0426     .005                         .004                        L.003          .05 51F
23 03 81 1200  0426    L.003                        L.003                        L.003          .04 51F

23 03 81 1600  0426     .050                        L.003                        L.003          .05 51F
23 03 81 1615  0426     .045                                                      .023          .04 51F
23 03 81 1700  0426      .11                         .005                        L.003          .16 51F
23 03 81 1800  0426     .013                         .009                        L.003          .05 51F
23 03 81 2000  0426      .15                         .004                        L.003          .06 51F

24 03 81 0000  0426      .36                          .14                        L.003          .07 51F
24 03 81 0400  0426      .28                         .006                        L.003          .15 51F
24 03 81 0800  0426    L.003                        L.003                        L.003          .07 51F
08 03 82 0800  0426     .009                         .004                        L.003          .24 51F
08 03 82 1200  0426     .008                         .003                        L.003          .17 51F

08 03 82 1600  0426     .005                         .003                        L.003          .14 51F
08 03 82 1615  0426     .006                         .003                        L.003          .15 51F
08 03 82 1700  0426     .006                        L.003                        L.003          .13 51F
08 03 82 1800  0426     .004                        L.003                        L.003          .13 51F
08 03 82 2000  0426     .005                        L.003                        L.003          .23 51F

09 03 82 0000  0426     .005                        L.003                        L.003          .14 51F
09 03 82 0400  0426     .003                        L.003                        L.003          .15 51F
09 03 82 0800  0426     .003                        L.003                        L.003          .13 51F
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                                                    NAQUADAT DETAILED REPORT
                                                 PARTICULATES TEMP DOC

STATION 00AT05BH2105    LAT. 51D  6M  0S  LONG. 114D 12M 36S   PR 3   UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

                              020615     02073L     10401L     10501L     07902F     06902F      06104F
                            TEMPERATURE TURBIDITY   RESIDUE    RESIDUE   NITROGEN    CARBON      CARBON
                                OF                 NONFILTR.    FIXED    PARTICUL.   ORGANIC    DISSOLVED
  SAMPLE DATE                 WATER                          NONFILTR.             PARTICULATE   ORGANIC
      MST            SUBM                                                   N          C           C
 D  M  Y  HR         ID        DEG.C.      JTU        MG/L       MG/L      MG/L       MG/L        MG/L

14 05 79 1010  0426     6.         6.1        7.         L1.        .07
14 05 79 1015  0426     6.         8.4        3.         2.         .04
28 05 79 0805  0426    12.5        5.5        3.         0.         .05
28 05 79 0840  0426    12.5        4.8        3.         2.         .05
11 06 79 0735  0426    12.         3.2        2.         1.         .05

11 06 79 0800  0426    12.         2.5        3.         2.         .03
25 06 79 0835  0426    14.         7.2        2.         L1.        .03
25 06 79 0855  0426    14.         6.3        3.         L1.        .02
09 07 79 1210  0426    16.         2.3        4.         2.         .03
09 07 79 1230  0426    16.         2.3        L1.        L1.

23 07 79 1245  0426    15.5                   L1.        L1.        .02
23 07 79 1300  0426    15.5                   L1.        L1.
05 08 79 0705  0426    14.5         .9         2.0        1.4       .03
05 08 79 0720  0426    14.5         .6         1.6       L1.
20 08 79 1130  0426    16.          .5         1.6        1.7       .07

20 08 79 1145  0426    16.          .5        L1.        L1.
23 09 79 1230  0426    13.         1.2        2.         L1.        .09
23 09 79 1235  0426    13.          .7        2.         1.
08 10 79 1125  0426    11.         1.1        1.         1.        L.01
08 10 79 1130  0426    11.          .8        1.         L1.

28 10 79 1455  0426     7.         1.5        L1.        L1.        .39
28 10 79 1500  0426     7.         2.5        2.         1.
18 11 79 1255  0426     3.          .4        L1.        L1.        .04 02L
18 11 79 1300  0426     3.          .4        L1.        L1.
09 12 79 1640  0426     1.         1.7        L1.        1.         .03 02L

09 12 79 1645  0426     1.         5.8        L1.        L1.
07 01 80 1425  0426     0.          .9        4.         3.         .04 02L    .32 02L     2. 06L
07 01 80 1430  0426     0.         1.6        4.         3.                                2. 04L
28 01 80 1140  0426     0.          .4        L1.        L1.        .02 02L    .11 02L     1. 06L
28 01 80 1145  0426     0.         1.1        1.         1.                                1. 04L

18 02 80 1210  0426     0.          .8        L1.        L1.        .03 02L    .11 02L     1. 06L
18 02 80 1215  0426     0.          .5        L1.        L1.                               1.
27 10 80 0815  0426     4.0 61F
27 10 80 1200  0426     5.0 61F
27 10 80 1600  0426     6.0 61F

27 10 80 1615  0426     6.0 61F
27 10 80 1700  0426     5.0 61F
27 10 80 1800  0426     5.0 61F
27 10 80 2000  0426     4.0 61F
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                                                      NAQUADAT DETAILED REPORT
                                               PARTICULATES TEMP DOC

STATION 00AT05BH2105    LAT. 51D  6M  0S  LONG. 114D 12M 36S   PR 3   UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

                            02061S      02073L        10401L        10501L        07902F        06902F         06104F
                          TEMPERATURE  TURBIDITY      RESIDUE       RESIDUE      NITROGEN       CARBON         CARBON
                              OF                     NONFILTR.       FIXED       PARTICUL.     ORGANIC        DISSOLVED
  SAMPLE DATE               WATER                                  NONFILTR.                  PARTICULATE      ORGANIC
     MST           SUBM                                                             N             C               C
 D  M  Y  HR        ID       DEG.C.       JTU          MG/L          MG/L          MG/L          MG/L            MG/L

28 10 80 0000     0426        4.0 61F
28 10 80 0400     0426        4.0 61F
28 10 80 0800     0426        4.0 61F
05 01 81 0800     0426        0.  61F
05 01 81 1200     0426        0.  61F

05 01 81 1600     0426        0.  61F
05 01 81 1615     0426        0.  61F
05 01 81 1700     0426        0.  61F
05 01 81 1800     0426        0.  61F
05 01 81 2000     0426        0.  61F

06 01 81 0000     0426        0.  61F
06 01 81 0400     0426        0.  61F
06 01 81 0800     0426        0.  61F
23 03 81 0800     0426        1.  61F
23 03 81 1200     0426        3.  61F

23 03 81 1600     0426        3.  61F
23 03 81 1615     0426        3.  61F
23 03 81 1700     0426        2.  61F
23 03 81 1800     0426        2.  61F
23 03 81 2000     0426        1.0 61F

24 03 81 0000     0426        1.0 61F
24 03 81 0400     0426        1.0 61F
24 03 81 0800     0426        1.0 61F
08 03 82 0800     0426        2.5 61F
08 03 82 1200     0426        3.2 61F

08 03 82 1600     0426        3.5 61F
08 03 82 1615     0426        3.5 61F
08 03 82 1700     0426        3.5 61F
08 03 82 1800     0426        3.5 61F
08 03 82 2000     0426        3.0 61F

09 03 82 0000     0426        3.0 61F
09 03 82 0400     0426        3.0 61F
09 03 82 0800     0426        3.0 61F
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NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BH2105 LAT. 51D 6M 0S LONG. 114D 12M 36S PR 3 UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
14	05	79	1010	0426			115.		325.		
14	05	79	1015	0426			117.		324.		
28	05	79	0805	0426	8.2		110.	.0	312.		
28	05	79	0840	0426	8.1		110.	.0	314.		
11	06	79	0735	0426	8.1		92.	.0	241.		
11	06	79	0800	0426	8.0		92.	.0	262.		
25	06	79	0835	0426	7.9		93.	.0	256.		
25	06	79	0855	0426	8.1		95.	.0	260.		
09	07	79	1210	0426	8.3		84.	.0	241.		
09	07	79	1230	0426	8.3		84.	.0	241.		
23	07	79	1245	0426	8.2		89.	.0	236.		
23	07	79	1300	0426	8.2		87.	.0	247.		
05	08	79	0705	0426	8.2		90.	20.	247.		
05	08	79	0720	0426	8.3		93.	27.	233.		
20	08	79	1130	0426	8.4		95.		268.		
20	08	79	1145	0426	8.4		95.		254.		
23	09	79	1230	0426	8.0		99.	.0	273.		
23	09	79	1235	0426	8.3		107.	.0	302.		
08	10	79	1125	0426	8.0		121.	.0	292.		
08	10	79	1130	0426	8.3		120.	.0	311.		
28	10	79	1455	0426	8.3		115.	.0	321.		
28	10	79	1500	0426	8.4		116.		323.		
18	11	79	1255	0426	8.3		115.	.0	331.		
18	11	79	1300	0426	8.3		117.	.0	330.		
09	12	79	1640	0426	8.2		100.	.0	348.		
09	12	79	1645	0426	8.3		98.	.0			
07	01	80	1425	0426	8.0	32. 53L	132.	.0	381.		4.3
07	01	80	1430	0426	8.1	33. 52L	132.	.0	385.		4.2
28	01	80	1140	0426	8.1	30. 53L	122.	.0	352.		4.0
28	01	80	1145	0426	8.1	30. 52L	122.	.0	365.		4.3
18	02	80	1210	0426	8.1	25. 53L	96.	.0	371.		4.4
18	02	80	1215	0426	8.2	26. 52L	94.	.0	381.		4.4
27	10	80	0815	0426	8.3				330.		
27	10	80	1200	0426	8.4				318.		
27	10	80	1600	0426	8.4				320.		
27	10	80	1615	0426	8.3				318.		
27	10	80	1700	0426	8.3				319.		
27	10	80	1800	0426	8.3				318.		
27	10	80	2000	0426	8.3				320.		

NAQUADAT DETAILED REPORT

PH DIC ALK COND CL SIO2

STATION 00AT05BH2105 LAT. 51D 6M 0S LONG. 114D 12M 36S PR 3 UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
28	10	80	0000	0426	8.3				319.		
28	10	80	0400	0426	8.3				320.		
28	10	80	0800	0426	8.3				320.		
05	01	81	0800	0426	8.2				353.		
05	01	81	1200	0426	8.2				351.		
05	01	81	1600	0426	8.2				350.		
05	01	81	1615	0426	8.2				350.		
05	01	81	1700	0426	8.2				350.		
05	01	81	1800	0426	8.3				352.		
05	01	81	2000	0426	8.1				352.		
06	01	81	0000	0426	8.2				349.		
06	01	81	0400	0426	8.2				349.		
06	01	81	0800	0426	8.3				353.		
23	03	81	0800	0426	8.3				342.		
23	03	81	1200	0426	8.3				338.		
23	03	81	1600	0426	8.3				336.		
23	03	81	1615	0426	8.3				339.		
23	03	81	1700	0426	8.3				337.		
23	03	81	1800	0426	8.3				344.		
23	03	81	2000	0426	8.1				342.		
24	03	81	0000	0426	8.2				345.		
24	03	81	0400	0426	8.2				340.		
24	03	81	0800	0426	8.2				341.		
08	03	82	0800	0426	8.0				315.		
08	03	82	1200	0426	8.1				311.		
08	03	82	1600	0426	8.1				314.		
08	03	82	1615	0426	8.1				316.		
08	03	82	1700	0426	8.1				312.		
08	03	82	1800	0426	8.1				314.		
08	03	82	2000	0426	8.0				315.		
09	03	82	0000	0426	8.0				313.		
09	03	82	0400	0426	8.0				310.		
09	03	82	0800	0426	8.0				313.		

NAQUADAT DETAILED REPORT

P AND N FORMS PLUS TEMP PH COND

STATION 20AL05BH8500 LAT. 51D 0M 25S LONG. 114D 0M 15S FR 3 UTM 11 710150E 5654650N
CALGARY - BONNYBROOK SEWAGE TREATMENT PLANT EFFLUENT TO BOW RIVER - GRAB
SW1/4 S1 T24 R1 W5M

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	02061S TEMPERATURE OF WATER DEG.C.	10301L PH PH UNITS	02041L SPECIFIC CONDUCT. US/CM
09 06 80 1100	0426	2.2	2.2	2.0	8.8 51F	14.0 61F	7.3 01F	1000. 41F
09 06 80 1500	0426	3.3	3.0	2.9	17. 51F	15.0 61F	7.4 01F	1150. 41F
09 06 80 1515	0426	3.5	3.1	3.1	17. 51F	15.0 61F	7.4 01F	1150. 41F
09 06 80 1600	0426	3.7	3.3	3.3	18. 51F	15.0 61F	7.4 01F	1150. 41F
09 06 80 1700	0426	3.8	3.6	3.6	19. 51F	15.0 61F	7.4 01F	1200. 41F
09 06 80 1900	0426	4.2	4.0	3.9	18. 51F	15.0 61F	7.4 01F	1100. 41F
09 06 80 2300	0426	5.0	4.0	4.0	18. 51F	15.0 61F	7.3 01F	1050. 41F
10 06 80 0300	0426	4.4	4.0		17. 51F	15.0 61F	7.3 01F	1000. 41F
10 06 80 0700	0426	4.0	3.9	3.9	18. 51F	15.0 61F	7.3 01F	1050. 41F
10 06 80 1100	0426	3.2	3.0	3.0	19. 51F	15.0 61F	7.3 01F	1100. 41F
05 08 80 0700	0426	4.4	4.0	3.9	13. 51F	17.7 61F	7.5 01F	920. 41F
05 08 80 1100	0426	3.2	3.0	3.0	11. 51F	17.4 61F	7.5 01F	950. 41F
05 08 80 1500	0426	4.2	3.6	3.6	14. 51F	18.0 61F	7.5 01F	1050. 41F
05 08 80 1515	0426	4.2	3.7	3.6	14. 51F	18.0 61F	7.5 01F	1050. 41F
05 08 80 1600	0426	4.2	3.8	3.6	15. 51F	18.0 61F	7.5 01F	1050. 41F
05 08 80 1700	0426	4.4	4.0	4.0	13. 51F	18.2 61F	7.5 01F	1100. 41F
05 08 80 1900	0426	4.6	4.1	4.0	14. 51F	18.4 61F	7.4 01F	1100. 41F
05 08 80 2300	0426	5.2	4.4	4.2	13. 51F	18.5 61F	7.4 01F	1000. 41F
06 08 80 0300	0426	4.2	3.8	3.8	10. 51F	18.5 61F	7.4 01F	950. 41F
06 08 80 0700	0426	2.4	2.4 03L	.55 56L	7.5 51L	18.1 61F	7.5 01F	980. 41F
06 10 80 0700	0426	4.1	3.8	3.7	13. 51F	15.0 61F	7.8	827.
06 10 80 1100	0426	3.5	3.2	3.2	13. 51F	16.0 61F	7.7	855.
06 10 80 1500	0426	3.8	3.5	3.4	16. 51F	17.0 61F	7.7	957.
06 10 80 1515	0426	4.1	3.7	3.6	15. 51F	17.0 61F	7.7	974.
06 10 80 1600	0426	4.0	3.9	3.8	14. 51F	17.0 61F	7.8	986.
06 10 80 1700	0426	4.6	4.2	4.2	14. 51F	17.0 61F	7.7	995.
06 10 80 1900	0426	5.2	4.6	4.4	16. 51F	17.0 61F	7.7	1000.
06 10 80 2300	0426	5.0	5.0	5.0	14. 51F	16.0 61F	7.7	966.
07 10 80 0300	0426	5.8	4.6	4.4	11. 51F	16.0 61F	7.7	886.
07 10 80 0700	0426	3.6	2.9	2.8	12. 51F	16.0 61F	7.7	871.
15 01 81 0800	0426	3.0	2.6	2.4	12. 51F		7.6	778.
15 01 81 1157	0426	3.4	3.2	2.6	15. 51F		7.7	825.
15 01 81 1558	0426	4.0	3.4	3.4	20. 51F		7.8	940.
15 01 81 1615	0426	4.2	3.8	3.8	20. 51F		7.7	942.
15 01 81 1700	0426	2.0	1.6	1.6	7.8 51F		7.9	596.
15 01 81 1800	0426	3.8	3.5	3.5	18. 51F		7.8	905.
15 01 81 2001	0426	4.0	3.6	3.6	17. 51F		7.7	919.
16 01 81 0000	0426	2.4	2.1	2.1	8.4 51F		7.8	668.
16 01 81 0400	0426		3.5	3.5	9.8 51F		8.0	829.

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                                                        NAQUADAT DETAILED REPORT
                                                P AND N FORMS PLUS TEMP PH COND

STATION 20AL05BH8500    LAT. 51D  0M 25S  LONG. 114D  0M 15S   PR 3   UTM 11 710150E 5654650N
CALGARY - BONNYBROOK SEWAGE TREATMENT     PLANT EFFLUENT TO BOW RIVER - GRAB
SW1/4  S1 T24 R1 W5M

                               15406L       15103F        15256F        07661F       02061S       10301L       02041L
                             PHOSPHOROUS  PHOSPHORUS    PHOSPHORUS     NITROGEN   TEMPERATURE      PH        SPECIFIC
                                TOTAL      DISSOLVED    DISSOLVED     DISSOLVED       OF                    CONDUCT.
  SAMPLE DATE                 PHOSPHATE                  ORTHO PO4        N         WATER
      MST            SUBM         P            P             P
 D  M  Y  HR          ID        MG/L         MG/L          MG/L          MG/L         DEG.C.     PH UNITS       US/CM

16 01 81 0800       0426        3.2          3.2           3.2          11.   51F                  7.9          824.
25 03 81 0800       0426        3.0          2.8           2.8          20.   51F                  7.6          865.
25 03 81 1200       0426        2.8          2.8           2.8          19.   51F      9.0 61F     7.6          856.
25 03 81 1600       0426        3.0          3.0           2.8          23.   51F     10.0 61F     7.6          964.
25 03 81 1615       0426        3.2          3.2           3.0          25.   51F     10.0 61F     7.6          977.

25 03 81 1705       0426        3.4          3.2           3.2          24.   51F      9.0 61F     7.6          997.
25 03 81 1800       0426        3.4          3.2           3.2          26.   51F     10.0 61F     7.6          969.
25 03 81 1952       0426        3.4          3.2           3.2          26.   51F     11.0 61F     7.6          997.
26 03 81 0000       0426        3.6          3.6           3.4          25.   51F     11.0 61F     7.6         1008.
26 03 81 0355       0426        2.8          2.8           2.6          17.   51F      9.0 61F     7.6          829.

26 03 81 0800       0426        2.8          2.8           2.8          18.   51F      9.0 61F     7.6          861.
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NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
28 01 80 0940	0426	.32	.31	.29 13L	.28 46L	.26 66L		.68 19L	2.0
28 01 80 0945	0426	.33	.30	.29 03L	.28 56L	.27 56L	2.0 51L	.68 10L	1.6
18 02 80 0955	0426	.34	.28	.34 13L	.28 46L	.25 66L	2.0 61L	.68 19L	1.6
18 02 80 1000	0426	.34	.30	.28 03L	.28 56L	.27 56L	2.0 51L	.64 10L	
10 03 80 1135	0426	.29	.28	.26 13L	.26 46L	.25 66L	1.6 61L	.60 19L	
10 03 80 1140	0426	.29	.29	.27 03L	.26 56L	.25 56L	1.8 51L	.55 10L	1.4
24 03 80 1355	0426	.33	.30	.28 13L	.28 46L	.27 66L	2.6 61L	.45 19L	1.4
24 03 80 1400	0426	.34	.31	.28 03L	.26 56L	.26 56L	2.7 51L	.44 10L	1.4
08 04 80 0955	0426	.30	.28	.23 13L	.22 46L	.21 66L	1.7 61L	.50 19L	1.5
08 04 80 1000	0426	.29	.27	.23 03L	.21 56L	.21 56L	1.8 51L	.51 10L	1.6
21 04 80 0955	0426	.27	.21	.19 13L	.18 46L	.16 66L	1.3 61L	.45 19L	.9
21 04 80 1000	0426	.25	.22	.17 03L	.16 56L	.14 56L	1.3 51L	.45 10L	.8
05 05 80 0935	0426	.20	.19	.15 13F	.15 46F	.14 66F	1.07	.46 19F	.5
05 05 80 0940	0426	.20	.19	.16	.11	.11	.99 51F	.43	.6
05 05 80 1150	0426	.21		.16		.12	.96 51F		
05 05 80 1500	0426	.25		.19		.15	.99 51F		
05 05 80 1900	0426	.24		.19		.15	1.12 51F		
05 05 80 1915	0426	.24		.19		.15	1.14 51F		
05 05 80 2000	0426	.24		.19		.15	1.15 51F		
05 05 80 2100	0426	.25		.20		.16	1.3 51F		
05 05 80 2300	0426	.26		.20		.16	1.4 51F		
06 05 80 0300	0426	.26		.19		.15	1.3 51F		
06 05 80 0700	0426	.22		.16		.12	1.04 51F		
06 05 80 1100	0426	.20		.14		.10	.86 51F		
20 05 80 0955	0426	.17	.16	.13 13F	.12 46F	.067 66F	1.5		.3
20 05 80 1000	0426	.19		.16	.099	.068	1.3 51F	.39	.6
20 05 80 1030	0426	.19	.17	.12	.12	.11	.79 51F	.39	.5
20 05 80 1031	0426	.19	.17	.13	.10	.096	.80 51F	.40	.5
20 05 80 1032	0426	.19	.14	.13	.11	.10	.78 51F	.40	.5
20 05 80 1033	0426	.19	.16	.12	.11	.11	.85 51F	.40	.6
20 05 80 1034	0426	.20	.17	.13	.12	.11	.74 51F	.40	.2
20 05 80 1400	0426	.21	.19	.15	.14	.13	.83 51F	.39	.2
20 05 80 1401	0426	.21	.14	.15	.14	.13	.84 51F	.40	.4
20 05 80 1402	0426	.20	.17	.15	.13	.13	.84 51F	.40	.4
20 05 80 1403	0426	.20	.18	.15	.14	.13	.84 51F	.38	.6
02 06 80 0700	0426	.14	.12	.082	.065	.044	.94	.40	.5
16 06 80 1000	0426	.070	.060	.038	.020	L.003	.51	.28	L.1
01 07 80 1000	0426	.10	.015	.094		.013	.84	.42	.3
14 07 80 1130	0426	.19	.17	.18	.16	.14	1.1	.72	.5

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
28 07 80 0700	0426	.14		.12		.092	1.1 51F		
28 07 80 1030	0426	.14	.13	.11	.10	.068	1.2	1.1	.3
28 07 80 1100	0426	.14		.12		.10	.93 51F		
28 07 80 1500	0426	.17		.15		.14	1.0 51F		
28 07 80 1900	0426	.18		.16		.15	1.2 51F		
28 07 80 1915	0426	.18		.17		.14	1.2 51F		
28 07 80 2000	0426	.18		.16		.13	1.24 51F		
28 07 80 2100	0426	.18		.17		.13	1.36 51F		
28 07 80 2300	0426	.20		.18		.16	1.38 51F		
29 07 80 0300	0426	.25		.22		.20	1.45 51F		
29 07 80 0700	0426	.27		.24		.22	1.40 51F		
11 08 80 0950	0426	.17	.13	.15	.13	.12	1.1	1.1	
25 08 80 1000	0426		.16	.16	.14	.12	1.7	1.2	.4
08 09 80 1000	0426	.26	.23	.22	.21	.16	1.6	1.2	.3
22 09 80 1000	0426	.23	.22	.22	.20	.20	1.6	1.4	.3
06 10 80 1000	0426	.27	.25	.24	.22	.20	1.6	1.3	.2
13 10 80 0700	0426	.19		.17		.16	1.3 51F	1.2	
13 10 80 1100	0426	.20		.16		.15	1.2 51F	1.0	
13 10 80 1500	0426	.20		.16		.15	1.1 51F	.90	
13 10 80 1900	0426	.21		.18		.17	1.3 51F	1.1	
13 10 80 1915	0426	.21		.18		.18	1.3 51F	1.2	
13 10 80 2000	0426	.22		.19		.18	1.4 51F	1.2	
13 10 80 2100	0426	.22		.19		.19	1.4 51F	1.3	
13 10 80 2300	0426	.23		.20		.20	1.5 51F	1.3	
14 10 80 0300	0426	.26		.22		.22	1.5 51F	1.4	
14 10 80 0700	0426	.26		.25		.22	1.4 51F	1.3	
20 10 80 1100	0426	.24	.21	.22	.20	.18	1.4	1.1	.2
03 11 80 1400	0426	.24	.18	.24	.18	.18	1.2	.80	.4
18 11 80 1000	0426	.35	.28	.26	.25	.24	1.6	.85	.4
08 12 80 1130	0426	.43	.39	.37	.36	.35		.75	2.8
05 01 81 1214	0426	.29	.25	.22	.19	.18	1.3	.49	.6
12 01 81 0800	0426	.26		.24		.21	.95 51F		
12 01 81 1200	0426	.26		.21		.20	.95 51F		
12 01 81 1600	0426	.24		.24		.24	.95 51F		
12 01 81 2000	0426	.28		.25		.24	1.0 51F		
12 01 81 2015	0426	.30		.25		.24	1.1 51F		
12 01 81 2100	0426	.28		.25		.24	1.2 51F		
12 01 81 2200	0426	.29		.25		.24	1.2 51F		
13 01 81 0000	0426	.31		.27		.26	1.2 51F		

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
13 01 81 0515	0426	.33		.30		.29	1.4 51F		
13 01 81 0800	0426	.31		.29		.28	1.5 51F		
26 01 81 1230	0426	.24	.22	.19	.17	.17	.97	.43	.8
16 02 81 1200	0426	.27	.24	.21	.21	.18		.46	1.4
09 03 81 1015	0426	.27	.27	.22	.22	.22	1.6	.60	.8
20 03 81 1215	0426	.26	.22	.21	.19	.20	1.8	.50	1.
30 03 81 0800	0426	.44		.22		.19	1.6 51F		
30 03 81 1200	0426	.47		.32		.30	2.2 51F		
30 03 81 1600	0426	.42		.33		.31	2.2 51F		
30 03 81 2000	0426	.40		.31		.31	2.3 51F		
30 03 81 2015	0426	.39		.31		.31	2.3 51F		
30 03 81 2100	0426	.38		.31		.31	2.5 51F		
30 03 81 2200	0426	.38		.31		.31	2.6 51F		
31 03 81 0000	0426	.38		.31		.30	2.7 51F		
31 03 81 0400	0426	.38		.30		.30	2.7 51F		
31 03 81 0800	0426	.37		.30		.29	2.4 51F		
06 04 81 1430	0426	.27	.24	.20	.20	.20		.40	1.2
21 04 81 1300	0426	.26	.21	.22	.20	.20	1.9	.48	1.0
04 05 81 1010	0426			.31 03L		.29 56L		.86	
04 05 81 1030	0426			.26 03L		.25 56L		.81	
04 05 81 1230	0426	.34	.32	.28	.26	.26		2.0	1.5
18 05 81 1305	0426			.050 03L		.039 56L		.30	
18 05 81 1320	0426			.066 03L		.050 56L		.35	
19 05 81 1450	0426	.20	.16	.10	.087	.074	.69	.38	.3
31 05 81 0735	0426			.022 03L		.013 56L		.18	
31 05 81 0737	0426			.019 03L		.012 56L		.17	
02 06 81 0800	0426	.10	.078	.032	.027	.019	.50	.36	L.1
02 06 81 0805	0426	.097	.079	.036	.033	.024	.48	.36	L.1
02 06 81 0815	0426	.093	.073	.033	.030	.024	.83	.36	L.1
02 06 81 0816	0426	.096	.081	.035	.029	.024	1.1	.36	L.1
02 06 81 0825	0426	.11	.083	.036	.032	.026	.81	.36	L.1
09 06 81 1030	0426	.15	.13	.042	.037	.029	.51	.26	L.1
15 06 81 0734	0426			.062 03L		.033 56L		.24	
15 06 81 0735	0426			.061 03L		.046 56L		.26	
29 06 81 1055	0426			.035 03L		.026 56L		.29 10L	
29 06 81 1105	0426			.067 03L		.056 56L		.33 10L	
30 06 81 1400	0426	.11	.090	.059	.050	.048	.91	.83	L.1
14 07 81 1050	0426			.087		.086		.47	
14 07 81 1110	0426			.047		.041		.36	

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
20 07 81 1200	0426	.097	.088	.041	.038	.028	.53	.48	L.1
28 07 81 1100	0426			.036		.029		.25	
28 07 81 1110	0426			.051		.044		.32	
08 08 81 1630	0426	.051		.039	.033	.033	.82	.70	L.1
11 08 81 1115	0426			.036		.024		.32	
11 08 81 1125	0426			.080		.068		.43	
23 08 81 1130	0426			.043		.033		.28	
23 08 81 1145	0426			.074		.062		.39	
24 08 81 1430	0426	.13	.13	.075	.072	.070	.77	.74	L.1
07 09 81 1100	0426			.052		.044		.40	
07 09 81 1110	0426			.085		.073		.52	
20 09 81 1100	0426			.16		.16		1.1	
20 09 81 1105	0426			.19		.18		1.2	
21 09 81 0915	0426	.20	.18	.14	.13	.13	1.9	1.85	L.1
04 10 81 1150	0426			.11		.10		.68	
04 10 81 1200	0426			.15		.14		.82	
15 10 81 0900	0426	.26	.26	.24	.22	.22	2.1	1.8	L.1
23 10 81 1445	0426			.23		.22		1.6	
23 10 81 1500	0426			.28		.26		1.8	
01 11 81 1210	0426			.15		.14		.94	
01 11 81 1215	0426			.18		.17		1.1	
02 11 81 1200	0426	.35	.31	.26	.24	.24	1.8	1.7	.3
12 11 81 1225	0426			.17		.17		.86	
12 11 81 1235	0426			.24		.23		.92	
23 11 81 1130	0426	.19	.17	.15	.14	.14	1.8	1.8	.2
23 11 81 1200	0426	.19	.17	.16	.14	.14	1.9	1.9	L.1
14 12 81 0950	0426	.58	.56	.29	.28	.28	2.3	1.7	.2
08 01 82 1000	0426	.45	.43	.32	.29	.29	2.8	2.3	L.1
01 02 82 1500	0426	.28	.27	.26	.26	.23	1.9	1.7	.5
24 02 82 1130	0426	.27	.26	.24	.23	.20	2.4	2.4	L.1
15 03 82 1000	0426	.37	.35	.12	.12	.10	2.2	2.0	L.1
05 04 82 1120	0426	.34	.31	.15	.15	.15	2.1	2.1	L.1
28 04 82 1130	0426	.33	.32	.14	.14	.14	1.4	1.4	L.1

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
28 01 80 0940	0426	2.	2.0	L1.	L1.	.08 02L	.51 02L	1. 06L
28 01 80 0945	0426	2.	1.1	2.	1.			1. 04L
18 02 80 0955	0426	0.	3.0	5.	3.	1.9 02L	1.1 02L	1. 06L
18 02 80 1000	0426	0.	1.5	7.	6.			1.
10 03 80 1135	0426	2.	1.2	6.	3.	.20 02L	1.4 02L	1. 06L
10 03 80 1140	0426	2.	1.2	3.	1.			1. 04L
24 03 80 1355	0426	4.	3.2	8.	6.	.24 02L	1.3 02L	2. 06L
24 03 80 1400	0426	4.	2.8	6.	6.			2. 04L
08 04 80 0955	0426	2. 61F	3.6	10.	7.			3. 06L
08 04 80 1000	0426	2. 61F	3.1	8.	6.			3. 04L
21 04 80 0955	0426	7.0 61F	.3	13.	10.			2. 06L
21 04 80 1000	0426	7. 61F	.3	8.	6.			2. 04L
05 05 80 0935	0426		1.9	5.	3.	.27	1.5	1. 06F
05 05 80 0940	0426		2.7	8.	5.			2.
05 05 80 1150	0426	12.5 61F						
05 05 80 1500	0426	13.8 61F						
05 05 80 1900	0426	13.5 61F						
05 05 80 1915	0426	13.5 61F						
05 05 80 2000	0426	13.3 61F						
05 05 80 2100	0426	13.0 61F						
05 05 80 2300	0426	12.8 61F						
06 05 80 0300	0426	11.5 61F						
06 05 80 0700	0426	10.0 61F						
06 05 80 1100	0426	10.5 61F						
20 05 80 0955	0426	15. 61F	2.0	9.	8.	.24	1.3	2. 06F
20 05 80 1000	0426	15. 61F	2.7	16.	14.			2.
20 05 80 1030	0426			8.	5.	.21	1.4	2.
20 05 80 1031	0426			9.	6.	.16	1.2	2.
20 05 80 1032	0426			12.	8.	.15	1.0	2.
20 05 80 1033	0426			14.	10.	.18	1.2	2.
20 05 80 1034	0426			13.	10.	.18	1.2	2.
20 05 80 1400	0426			9.	8.	.15	.91	2.
20 05 80 1401	0426			7.	6.	.13	.77	2.
20 05 80 1402	0426			11.	11.	.15	.82	2.
20 05 80 1403	0426			10.	9.	.11	.57	2.
02 06 80 0700	0426	11. 61F	17.0	29.0	26.0	.13	.86	3.
16 06 80 1000	0426	13. 61F	1.7	7.0	6.0	.11	.74	3.
01 07 80 1000	0426	15. 61F	2.0	2.0	1.0	.10	.37	1.
14 07 80 1130	0426		1.5	L1.	L1.			2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
28	07	80	0700	0426	17.1 61F						
28	07	80	1030	0426	16.0 61F	2.5	5.	3.	.20	1.0	1.
28	07	80	1100	0426	17.9 61F						
28	07	80	1500	0426	20.4 61F						
28	07	80	1900	0426	21.0 61F						
28	07	80	1915	0426	20.8 61F						
28	07	80	2000	0426	20.6 61F						
28	07	80	2100	0426	20.5 61F						
28	07	80	2300	0426	20.0 61F						
29	07	80	0300	0426	19.0 61F						
29	07	80	0700	0426	17.5 61F						
11	08	80	0950	0426	16.0 61F	1.5	4.	4.	.20	1.1	2.
25	08	80	1000	0426	13. 61F	2.0	4.	2.	.12	.68	2.
08	09	80	1000	0426	13. 61F	4.7	13.	10.	.20	1.2	2.
22	09	80	1000	0426	11. 61F	1.1	3.	1.	.04	.21	1.
06	10	80	1000	0426	12. 61F	1.1	1.	L1.	.15	.84	2.
13	10	80	0700	0426	10.0 61F						
13	10	80	1100	0426	10.0 61F						
13	10	80	1500	0426	11.0 61F						
13	10	80	1900	0426	11.0 61F						
13	10	80	1915	0426	11.0 61F						
13	10	80	2000	0426	11.0 61F						
13	10	80	2100	0426	11.0 61F						
13	10	80	2300	0426	11.0 61F						
14	10	80	0300	0426	11.0 61F						
14	10	80	0700	0426	11.0 61F						
20	10	80	1100	0426	8. 61F	3.7	4.	3.	.08	.57	1.
03	11	80	1400	0426	0. 61F	1.4	3.	2.	.12	.64	1.
18	11	80	1000	0426		2.7	5.	3.	.15	.93	1.
08	12	80	1130	0426	0. 61F	2.2	7.	3.	.29	1.7	2.
05	01	81	1214	0426	0. 61F	2.9	6.	5.	.13	.83	2.
12	01	81	0800	0426	1. 61F						
12	01	81	1200	0426	1. 61F						
12	01	81	1600	0426	1. 61F						
12	01	81	2000	0426	1. 61F						
12	01	81	2015	0426	1. 61F						
12	01	81	2100	0426	1. 61F						
12	01	81	2200	0426	1. 61F						
13	01	81	0000	0426	1. 61F						

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
13	01	81	0515	0426	1. 61F						
13	01	81	0800	0426	1. 61F						
26	01	81	1230	0426		6.2	16.	11.	.20	1.4	2.
16	02	81	1200	0426		3.0	10.	8.	.16	.98	2.
09	03	81	1015	0426		1.8	15.	13.	.23	1.4	1.
20	03	81	1215	0426		3.0	14.	12.	.15	1.0	2.
30	03	81	0800	0426	4.0 61F						
30	03	81	1200	0426	4.0 61F						
30	03	81	1600	0426	6.0 61F						
30	03	81	2000	0426	5.0 61F						
30	03	81	2015	0426	5.0 61F						
30	03	81	2100	0426	5.0 61F						
30	03	81	2200	0426	5.0 61F						
31	03	81	0000	0426	5.0 61F						
31	03	81	0400	0426	4.0 61F						
31	03	81	0800	0426	4.0 61F						
06	04	81	1430	0426	5.0 61F	3.5	9.	8.	.18	.68	2.
21	04	81	1300	0426		2.5	179.	168.	.22	1.1	2.
04	05	81	1230	0426		5.0	19.	16.	.18	1.1	2.
18	05	81	1305	0426	11.0 61F						
18	05	81	1320	0426	11.0 61F						
19	05	81	1450	0426		25.	138.	128.	.28	1.8	4.
31	05	81	0735	0426	11.0 61F						
31	05	81	0737	0426	11.0 61F						
02	06	81	0800	0426			95.	85.	.15	1.1	3.
02	06	81	0805	0426			97.	88.	.18	1.3	3.
02	06	81	0815	0426			69.	62.	.15	1.1	3.
02	06	81	0816	0426			79.	69.	.14	1.0	4.
02	06	81	0825	0426			67.	57.	.17	1.4	4.
09	06	81	1030	0426	10.0 61F	25.	90.	85.	.25	2.1	3.
29	06	81	1055	0426	14.0 61F						
29	06	81	1105	0426	14.0 61F						
30	06	81	1400	0426		21.	27.	24.	.10	1.1	2.
14	07	81	1050	0426	13.0 61F						
14	07	81	1110	0426	13.0 61F						
20	07	81	1200	0426		24.	114.		.13	1.2	2.
28	07	81	1100	0426	16.0 61F						
28	07	81	1110	0426	16.0 61F						
08	08	81	1630	0426		14.0	247.	226.	.11	.58	2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2160   LAT. 50D 51M 18S LONG. 113D 56M 0S   PR 4   UTM 12 293600E 5637600N
BOW RIVER   STIERS RANCH

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
11	08	81	1115	0426	18. 61F						
11	08	81	1125	0426	17. 61F						
23	08	81	1130	0426	18. 61F						
23	08	81	1145	0426	18. 61F						
24	08	81	1430	0426	21.0 61F	10.0	50.	42.	.13	1.2	1.
07	09	81	1100	0426	15. 61F						
07	09	81	1110	0426	15. 61F						
20	09	81	1100	0426	14. 61F						
20	09	81	1105	0426	14. 61F						
21	09	81	0915	0426		7.2	39.	34.	.14	1.0	1.
04	10	81	1150	0426	9.5 61F						
04	10	81	1200	0426	8. 61F						
15	10	81	0900	0426		2.4	24.	22.	.12	.94	3.
23	10	81	1445	0426	6. 61F						
23	10	81	1500	0426	6. 61F						
02	11	81	1200	0426		3.6	15.	11.	.28	2.4	2.
12	11	81	1225	0426	7. 61F						
12	11	81	1235	0426	6. 61F						
23	11	81	1130	0426		3.2	6.	4.	.08	.38	2.
23	11	81	1200	0426		3.0	5.	4.	.11	.62	1.
14	12	81	0950	0426	.0 61F	8.5	112.	91.	.34	2.7	2.
08	01	82	1000	0426	.0 61F	2.4	16.	13.	.36	2.8	2.
01	02	82	1500	0426	.0 61F	2.2	2.	2.	.09	.36	2.
24	02	82	1130	0426	.0 61F	2.5	3.	2.	.09		2.
15	03	82	1000	0426	5.0 61F	25.	102.	91.	.46	3.7	2.
05	04	82	1120	0426	.0 61F	14.	27.	23.	.35	2.8	2.
28	04	82	1130	0426		16.	52.	42.	.27	2.0	4.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
28 01 80 0940	0426	7.8	34. 53L	141.	.0	444.		4.3
28 01 80 0945	0426	7.8	35. 52L	141.	.0	448.		4.5
18 02 80 0955	0426	7.8	28. 53L	109.	.0	449.		3.9
18 02 80 1000	0426	7.8	28. 52L	109.	.0	447.		4.0
10 03 80 1135	0426	7.8	26. 53L	132.	.0	420.		4.8
10 03 80 1140	0426	7.8	26. 52L	131.	.0	425.		4.5
24 03 80 1355	0426	8.2	24. 53L	120.	.0	441.		4.2
24 03 80 1400	0426	8.2	20. 52L	110.	.0	440.		3.9
08 04 80 0955	0426	7.6	22. 53L	130. 01L	.0	389.	8.8	4.0
08 04 80 1000	0426	7.8	22. 52L	130. 01L	.0	395.	6.9	3.8
21 04 80 0955	0426	7.6	28. 53L	130. 01L	0.	373.	4.6	3.1
21 04 80 1000	0426	7.8	28. 52L	130. 01L	0.	369.	4.5	3.2
05 05 80 0935	0426	8.0	24. 53F	120. 01L	0.	334.	3.8	2.5
05 05 80 0940	0426	8.0	23.	120. 01L	0.	328.	3.7	2.2
20 05 80 0955	0426	7.6	22. 53F	105. 01L	0.	306.	2.7	3.6
20 05 80 1000	0426	7.7	23.	105. 01L	0.	305.	2.7	3.2
20 05 80 1030	0426	8.0	22.	106. 01L	0.	307.	2.7	3.6
20 05 80 1031	0426		22.	101. 01L	0.	310.	2.7	3.6
20 05 80 1032	0426	8.0	22.	107. 01L	0.	306.	2.7	3.4
20 05 80 1033	0426	8.0	22.	103. 01L	0.	304.	2.7	3.8
20 05 80 1034	0426		22.		0.	322.	2.5	4.2
20 05 80 1400	0426	8.2	22.	106. 01L	0.	310.		
20 05 80 1401	0426	8.2	22.	105. 01L	0.	310.	3.0	3.2
20 05 80 1402	0426	8.2	22.	107. 01L	0.	309.	3.0	3.4
20 05 80 1403	0426	8.2	22.	106. 01L	0.	309.	3.0	3.4
02 06 80 0700	0426	7.9	23.	112. 01L	.0	315.	2.9	3.6
16 06 80 1000	0426	7.6		112. 01L	.0	314.	2.4	3.8
01 07 80 1000	0426	8.2	22.	113. 01L	.0	316.	2.7	3.4
14 07 80 1130	0426	8.7	25.	114. 01L		330.	3.7	2.0
28 07 80 1030	0426	7.9	24.	111. 01L	.0	324.	3.4	2.7
11 08 80 0950	0426	7.7	23.	108. 01L	.0	322.	3.4	3.6
25 08 80 1000	0426	8.1	24.	113. 01L	.0	336.	3.7	3.8
08 09 80 1000	0426	8.0	24.	114. 01L	.0	354.	4.5	3.4
22 09 80 1000	0426	8.1	28.	120. 01L	.0	360.	3.6	3.1
06 10 80 1000	0426	7.8	28.	120. 01L	.0	366.	4.7	2.3
13 10 80 0700	0426	7.7				361.		
13 10 80 1100	0426	7.7				361.		
13 10 80 1500	0426	8.1				352.		
13 10 80 1900	0426	7.8				369.		

NAQUADAT DETAILED REPORT

PH DIC ALK COND CL SIO2

STATION 00AT05BM2160   LAT. 50D 51M 18S LONG. 113D 56M 0S   PR 4   UTM 12 293600E 5637600N
BOW RIVER   STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
13 10 80 1915	0426	7.9				372.		
13 10 80 2000	0426	7.9				371.		
13 10 80 2100	0426	7.7				379.		
13 10 80 2300	0426	7.7				378.		
14 10 80 0300	0426	7.7				374.		
14 10 80 0700	0426	7.7				369.		
20 10 80 1100	0426	7.8	29.	122. 01L	.0	366.	3.9	2.8
03 11 80 1400	0426	8.3	33.	127. 01L	.0	377.	6.2	3.3
18 11 80 1000	0426	8.0	31.	133. 01L	.0	397.	6.4	3.4
08 12 80 1130	0426	8.0	32.	143. 01L	.0	432.	6.2	4.4
05 01 81 1214	0426	8.0	26.	135. 01L	.0	401.	4.7	4.1
12 01 81 0800	0426					386.		
12 01 81 1200	0426					386.		
12 01 81 1600	0426					388.		
12 01 81 2000	0426					395.		
12 01 81 2015	0426	7.8				401.		
12 01 81 2100	0426					400.		
12 01 81 2200	0426					401.		
13 01 81 0000	0426					403.		
13 01 81 0515	0426					403.		
13 01 81 0800	0426	7.9				401.		
26 01 81 1230	0426		35.	130. 01L	.0	376.	4.3	3.6
16 02 81 1200	0426	7.9	34.	125. 01L	.0	392.	6.9	3.3
09 03 81 1015	0426	8.2	37.	123. 01L	.0	384.	5.6	3.2
20 03 81 1215	0426	8.2	41.	131. 01L	.0	400.	.9	3.0
30 03 81 0800	0426	7.6				379.		
30 03 81 1200	0426	7.5				384.		
30 03 81 1600	0426	7.6				397.		
30 03 81 2000	0426	7.7				410.		
30 03 81 2015	0426	7.7				411.		
30 03 81 2100	0426	7.6				419.		
30 03 81 2200	0426	7.6				420.		
31 03 81 0000	0426	7.6				424.		
31 03 81 0400	0426	7.7				424.		
31 03 81 0800	0426	7.7				420.		
06 04 81 1430	0426	8.4	32.	127. 01L	.0	384.	4.2	3.3
21 04 81 1300	0426	8.2	31.	124. 01L	.0	394.	5.0	3.2
04 05 81 1010	0426	7.9				403.	6.0	2.8
04 05 81 1030	0426	8.0				394.	5.3	2.6

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
04	05	81	1230	0426	7.8	34.	131. 01L	.0	404.	5.8	2.8
18	05	81	1305	0426	8.2				371.	2.9	4.3
18	05	81	1320	0426	8.1				388.	3.7	5.1
19	05	81	1450	0426	8.1	34.	138. 01L	.0	390.	4.3	4.8
31	05	81	0735	0426	8.1				287.	1.4	4.2
31	05	81	0737	0426	8.1				287.	1.4	4.2
02	06	81	0800	0426	7.5	28.	121. 01L	.0	306.	1.7	5.0
02	06	81	0805	0426	7.8	28.	121. 01L	.0	303.	1.7	5.0
02	06	81	0815	0426	7.6	28.	118. 01L	.0	306.	1.7	5.0
02	06	81	0816	0426	7.7	27.	123. 01L	.0	308.	1.8	4.9
02	06	81	0825	0426	7.8	28.	122. 01L	.0	302.	1.8	4.9
09	06	81	1030	0426	7.7	28.	121. 01L	.0	314.	2.6	5.5
15	06	81	0734	0426	8.1				313.	1.7	4.3
15	06	81	0735	0426	8.1				324.	2.1	4.8
29	06	81	1055	0426	8.4				326.	1.9	3.3
29	06	81	1105	0426	8.4				333.	2.3	3.5
30	06	81	1400	0426	8.0	27.	126. 01L	.0	337.	3.0	4.0
14	07	81	1050	0426	8.5				299.	2.6	3.1
14	07	81	1110	0426	8.7				292.	2.0	2.8
20	07	81	1200	0426	8.0	28.	112. 01L	.0	292.	2.0	3.7
28	07	81	1100	0426	8.3				289.	1.7	3.6
28	07	81	1110	0426	8.3				299.	2.2	3.7
08	08	81	1630	0426	8.2	28.	117. 01L	.0	312.	2.8	4.1
11	08	81	1115	0426	8.4				300.	1.8	3.4
11	08	81	1125	0426	8.4				307.	2.2	3.3
23	08	81	1130	0426	8.5				301.	1.8	3.7
23	08	81	1145	0426	8.5				305.	2.1	3.8
24	08	81	1430	0426	8.0	28.	117. 01L	.0	313.	2.6	3.7
07	09	81	1100	0426	8.4				316.	2.0	3.4
07	09	81	1110	0426	8.3				320.	2.5	3.2
20	09	81	1100	0426	8.2				325.	4.1	2.8
20	09	81	1105	0426	8.0				329.	4.6	2.8
21	09	81	0915	0426	7.7	28.	124. 01L	.0	343.	4.0	2.8
04	10	81	1150	0426	8.2				341.	3.6	2.0
04	10	81	1200	0426	8.0				348.	4.1	2.2
15	10	81	0900	0426	7.6	28.	132. 01L	.0	391.	7.8	2.8
23	10	81	1445	0426	7.7				392.	5.9	2.0
23	10	81	1500	0426	7.8				400.	6.7	2.8
01	11	81	1210	0426	8.3				368.	4.0	2.2

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2160 LAT. 50D 51M 18S LONG. 113D 56M 0S PR 4 UTM 12 293600E 5637600N
BOW RIVER STIERS RANCH

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
01 11 81 1215	0426	8.2				377.	4.6	2.4
02 11 81 1200	0426	7.5	32.	133. 01L	.0	387.	5.4	2.6
12 11 81 1225	0426	8.5				370.	4.7	2.2
12 11 81 1235	0426	8.2				388.	5.5	2.6
23 11 81 1130	0426	7.5	24.	138. 01L	.0	388.	7.4	3.4
23 11 81 1200	0426	7.4	24.	136. 01L	.0	382.	7.4	3.4
14 12 81 0950	0426	7.3	35.	144. 01L	.0	412.	7.0	4.1
08 01 82 1000	0426	7.5	35.	149. 01L	.0	442.	9.0	4.8
01 02 82 1500	0426	7.5	31.	140. 01L	.0	389.	5.5	4.4
24 02 82 1130	0426	7.6	38.	140. 01L	.0	400.	8.5	4.6
15 03 82 1000	0426	7.6	34.	140. 01L	.0	422.	13.	4.8
05 04 82 1120	0426	7.8	35.	145. 01L	.0	410.	11.	4.8
28 04 82 1130	0426	7.7	24.	130. 01L	.0	353.	7.5	3.9

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2161 LAT. 50D 53M 34S LONG. 114D 27M 0S PR 3 UTM 11 679350E 5640800N
BOW RIVER AT HIGHWAY 22X, CALGARY

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
14 05 79 1355	0426	.12	.099	.089 13F	.083 46F	.068 66F	.81	.23 19F	.6
14 05 79 1430	0426	.11	.10	.077	.077	.077	.87 51F	.21	.6
28 05 79 1130	0426	.14	.11	.095 13F	.082 46F	.072 66F	.59	.20 19F	.5
28 05 79 1215	0426	.14	.13	.095	.082	.078	.64 51F	.20	.5
11 06 79 1020	0426	.25	.25	.16 13F	.14 46F	.13 66F	1.3	.35 19F	.1
11 06 79 1050	0426	.24	.21	.19	.16	.13	1.4 51F	.33	.1
25 06 79 1050	0426	.29	.26	.22 13F	.20 46F	.18 66F	1.7	.48 19F	1.6
25 06 79 1110	0426	.28	.27	.23	.21	.18		.37	1.6
09 07 79 0930	0426	.19	.16	.14 13F	.14 46F	.12 66F	1.0	.42 19F	.7
09 07 79 0950	0426	.18	.17	.13	.090	.13	.95 51F	.41	.2
23 07 79 0910	0426	.19	.16		.12 46F	.12 66F	1.2	.78 19F	.6
23 07 79 0925	0426	.18	.16	.16	.12	.14	.81 51F	.51	.5
05 08 79 1330	0426	.20	.17	.18 13F	.10 46F	.13 66F	1.18	.94 19F	L.1
05 08 79 1345	0426	.20	.20	.14	.17	.11	1.00 51F	.80	.4
20 08 79 0930	0426	.22	.18	.17 13F		.14 66F	1.3	1.1 19F	.1
20 08 79 0945	0426	.21	.19	.17	.15	.15	1.5 51F	1.3	.1
23 09 79 1430	0426	.35	.29	.31 13F	.29 46F	.29 66F	1.9	1.1 19F	.7
23 09 79 1450	0426	.36	.29	.31	.29	.29	1.8 51F	1.1	.9
08 10 79 1325	0426	.41	.36	.35 13F	.33 46F	.31 66F	2.3	1.5 19F	L.1
08 10 79 1330	0426	.42	.37	.34	.33	.31		1.5	1.7
28 10 79 1655	0426	.50			.45 46F	.42 66F	2.5	1.3 19F	.6
28 10 79 1700	0426	.52			.46	.43	2.5 51F	1.3	1.4
18 11 79 1525	0426	.55	.54	.54 13L	.46 46L	.42 66L	3.5 61L	1.1 19L	1.9
18 11 79 1530	0426	.80	.54	.48 03L	.46 56L	.40 56L	3.4 51L	1.1 10L	2.1
09 12 79 1525	0426	.74	.66	.46 13L	.50 46L	.46 66L	3.8 61L	.95 19L	1.8
09 12 79 1530	0426	.76	.64	.48 03L	.48 56L	.42 56L	3.6 51L	.90 10L	2.9
07 01 80 1310	0426	.38	.36	.32 13L	.32 46L	.30 66L	2.2 61L	.75 19L	1.7
07 01 80 1315	0426	.36	.34	.33 03L	.33 56L	.22 56L	2.6 51L	.75 10L	1.6
14 07 80 1020	0426	.094	.077	.087 03L	.068 56L	.061 56L	.80 61L	.46 10L	.4
07 09 80 1015	0426	.15	.14	.13 03L	.13 56L	.12 56L	.92 61L	.76 10L	.2
06 07 81 1000	0426	.014	.014	.008	.007	.003	.25	.19	L.1
31 08 81 0940	0426	.048	.041	.043	.034	.029		.32	.2

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2161 LAT. 50D 53M 34S LONG. 114D 27M 0S PR 3 UTM 11 679350E 5640800N
BOW RIVER AT HIGHWAY 22X, CALGARY

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
14 05 79 1355	0426	11.5	7.4	8.	2.	.12		
14 05 79 1430	0426	11.5	9.9	2.	L1.	.13		
28 05 79 1130	0426	13.	18.	13.	10.	.18		
28 05 79 1215	0426	13.	15.	12.	10.	.18		
11 06 79 1020	0426	12.5	1.9	6.	3.	.54		
11 06 79 1050	0426	12.5	2.3	10.	8.	.19		
25 06 79 1050	0426	14.5	4.3	L1.	L1.	.19		
25 06 79 1110	0426	14.5	4.1	1.	L1.	.16		
09 07 79 0930	0426	15.5	4.5	4.	2.	.11		
09 07 79 0950	0426	15.5	2.7	1.	L1.			
23 07 79 0910	0426	17.		2.	L1.	.15		
23 07 79 0925	0426	17.		L1.	L1.			
05 08 79 1330	0426	17.5	1.4	11.7	9.0	.08		
05 08 79 1345	0426	17.5	1.3	L1.	L1.			
20 08 79 0930	0426	15.5	.4	L1.	L1.	.07		
20 08 79 0945	0426	15.5	.7	2.6	2.			
23 09 79 1430	0426	14.	1.4	2.	L1.	.27		
23 09 79 1450	0426	14.	1.4	3.	1.			
08 10 79 1325	0426	10.	2.1	5.	1.			
08 10 79 1330	0426	10.	2.3	7.	4.			
28 10 79 1655	0426	2.	3.0	4.	3.	.39		
28 10 79 1700	0426	2.	5.5	4.	3.			
18 11 79 1525	0426	3.	2.5	4.	3.	.37 02L		
18 11 79 1530	0426	3.	1.5	4.	L1.			
09 12 79 1525	0426	3.	8.5	5.	2.	.38 02L		
09 12 79 1530	0426	3.	2.5	6.	3.			
07 01 80 1310	0426	0.	1.3	3.	L1.	.16 02L	.98 02L	3. 06L
07 01 80 1315	0426	0.	.9	3.	2.			2. 04L
14 07 80 1020	0426	15.2 61F		2.	2.	.06 02L	.36 02L	1. 04L
07 09 80 1015	0426	14.7 61F		9.	7.	.04 02L	.43 02L	2. 04L
06 07 81 1000	0426	14.0 61F		7.	6.	.06	.22	2.
31 08 81 0940	0426	14.0 61F		3.	2.	.04	.17	1.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2161 LAT. 50D 53M 34S LONG. 114D 27M 0S PR 3 UTM 11 679350E 5640800N
BOW RIVER AT HIGHWAY 22X, CALGARY

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
14	05	79	1355	0426					351.		
14	05	79	1430	0426			119.		354.		
28	05	79	1130	0426	8.1		116.	.0	343.		
28	05	79	1215	0426	8.0		116.	.0	342.		
11	06	79	1020	0426	8.1		111.	.0	327.		
11	06	79	1050	0426	8.1		111.	.0	327.		
25	06	79	1050	0426	8.0		113.	.0	333.		
25	06	79	1110	0426	8.0		113.	.0	331.		
09	07	79	0930	0426	8.1		110.	.0	327.		
09	07	79	0950	0426	8.2		108.	.0	326.		
23	07	79	0910	0426	7.5		104.	.0	289.		
23	07	79	0925	0426	7.5		103.	.0	300.		
05	08	79	1330	0426	8.5		99.	12.	303.		
05	08	79	1345	0426	8.5		103.	.0	303.		
20	08	79	0930	0426	7.8		100.	.0	320.		
20	08	79	0945	0426	7.7		103.	.0	323.		
23	09	79	1430	0426	8.0		117.	.0	352.		
23	09	79	1450	0426	8.0		114.	.0	355.		
08	10	79	1325	0426	7.7		137.	.0	391.		
08	10	79	1330	0426	7.8		128.	.0	396.		
28	10	79	1655	0426	7.6		137.	.0	422.		
28	10	79	1700	0426	7.6		138.	.0	424.		
18	11	79	1525	0426	7.8		140.	.0	435.		
18	11	79	1530	0426	7.8		140.		433.		
09	12	79	1525	0426	7.8		122.	.0	481.		
09	12	79	1530	0426	8.2		122.	.0			
07	01	80	1310	0426	7.7	35. 53L	146.	.0	454.		5.1
07	01	80	1315	0426	7.7	35. 52L	144.	.0	462.		5.1
14	07	80	1020	0426	8.7	22. 52L	113. 01L	5.9	310.	2.3	2.4
07	09	80	1015	0426	8.4	23. 52L	115. 01L	.1	334.	3.1	3.0
06	07	81	1000	0426	8.6	27.	118. 01L	3.2	298.	1.5	3.6
31	08	81	0940	0426	8.5	27.	117. 01L	.2	303.	1.8	1.2

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
15 05 79 0905	0426	.078	.073	.043 13F	.044 46F	.039 66F	.65	.31 19F	.1
15 05 79 0945	0426	.092	.070	.046	.045	.030	.65 51F	.32	.2
29 05 79 0615	0426	.15	.13	.058 13F	.042 46F	.047 66F	.53	.30 19F	.3
29 05 79 0645	0426	.16	.12	.058	.05	.046	.55 51F	.30	.2
12 06 79 0700	0426	.078	.05	.058 13F	.027 46F	.042 66F	.82	.50 19F	.2
12 06 79 0725	0426	.075	.051	.073	.043	.048	.82 51F	.55	.2
26 06 79 0615	0426	.15	.12	.11 13F	.094 46F	.086 66F	1.2	.74 19F	.3
26 06 79 0635	0426	.13	.12	.11	.094	.084	1.0 51F	.78	.2
09 07 79 0715	0426	.13	.12	.082 13F	.061 46F	.080 66F	.71	.54 19F	.1
09 07 79 0730	0426	.13	.13	.071	.065	.065	.82 51F	.56	L.1
23 07 79 0650	0426	.11	.091	.11 13F	.080 46F	.080 66F	.65	.53 19F	L.1
23 07 79 0705	0426	.11	.074		.075	.084	.59 51F	.50	L.1
05 08 79 1025	0426	.11	.075	.085 13F	.054 46F	.061 66F	.80	.80 19F	L.1
05 08 79 1040	0426	.093	.075	.074	.068	.052	.80 51F	.80	L.1
21 08 79 0825	0426	.16	.14	.13 13F	.11 46F	.11 66F	1.0	.92 19F	L.1
21 08 79 0830	0426	.15	.14	.13	.12	.11	.91 51F	.88	L.1
24 09 79 0640	0426	.20	.15	.16 13F	.15 46F	.15 66F	1.1	.96 19F	L.1
24 09 79 0645	0426	.20	.15	.16	.15	.15	1.1 51F	.90	L.1
09 10 79 0640	0426	.20	.18	.19 13F	.17 46F	.17 66F	1.4	1.3 19F	L.1
09 10 79 0645	0426	.21	.17	.18	.17	.17	1.4 51F	1.3	L.1
29 10 79 0755	0426	.28	.26	.27 13F	.25 46F	.24 66F	2.0	1.7 19F	L.1
29 10 79 0800	0426	.28	.25	.27	.25	.24	2.0 51F	1.7	L.1
19 11 79 0725	0426	.27	.24	.25 13L	.23 46L	.22 66L	2.4 61L	1.7 19L	.3
19 11 79 0730	0426	.27	.24	.23 03L	.22 56L	.22 56L	2.0 51L	1.7 10L	.3
10 12 79 0755	0426	.25	.23	.24 13L	.23 46L	.23 66L	1.9 61L	1.20 19L	.6
10 12 79 0800	0426	.26	.24	.25 03L	.23 56L	.23 56L	2.0 51L	1.6 10L	.7
07 01 80 1125	0426	.28	.26	.26 13L	.25 46L	.24 66L	2.2 61L	1.3 19L	1.0
07 01 80 1130	0426	.27	.26	.26 03L	.26 56L	.24 56L	2.3 51L	1.2 10L	.9
28 01 80 0825	0426	.26	.26	.24 13L	.23 46L	.23 66L	2.4 61L	1.4 19L	1.2
28 01 80 0830	0426	.28	.26	.24 03L	.24 56L	.24 56L	2.0 51L	1.3 10L	1.2
18 02 80 0825	0426	.26	.25	.24 13L	.23 46L	.22 66L	1.8 61L	1.2 19L	
18 02 80 0830	0426	.26	.25	.23 03L	.23 56L	.23 56L	2.0 51L	1.2 10L	.7
10 03 80 0955	0426	.26	.25	.22 13L	.22 46L	.21 66L	1.7 61L	.80 19L	.7
10 03 80 1000	0426	.26	.25	.22 03L	.22 56L	.22 56L	1.7 51L	1.0 10L	.7
24 03 80 0855	0426	.35	.31	.25 13L	.24 46L	.23 66L	1.8 61L	.86 19L	1.0
24 03 80 0900	0426	.42	.37	.25 03L	.25 56L	.24 56L	1.9 51L	.86 10L	1.0
08 04 80 0825	0426	.29	.26	.21 13L	.20 46L	.18 66L	1.5 61L	.58 19L	.9
08 04 80 0830	0426	.28	.25	.21 03L	.19 56L	.18 56L	1.6 51L	.56 10L	.9
21 04 80 0825	0426	.19	.16	.12 13L	.11 46L	.10 66L	.92 61L	.47 19L	.4

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
21 04 80 0830	0426	.30	.17	.12 03L	.11 56L	.093 56L	.84 51L	.47 10L	.4
05 05 80 1315	0426	.14	.14	.10 13F	.10 46F	.090 66F	.87	.50 19F	L.1
05 05 80 1320	0426	.16	.14	.11	.087	.087	.81 51F	.50	.4
12 05 80 1300	0426	.13		.088		.075	.67 51F		
12 05 80 1700	0426	.14		.088		.065	.68 51F		
12 05 80 2100	0426	.13		.088		.056	.81 51F		
13 05 80 0100	0426	.15		.10		.069	.79 51F		
13 05 80 0500	0426	.15		.10		.041	.97 51F		
13 05 80 0515	0426	.15		.10		.085	.97 51F		
13 05 80 0600	0426	.14		.11		.054	.97 51F		
13 05 80 0700	0426	.14		.12		.051	.97 51F		
13 05 80 0900	0426	.14		.099		.054	.93 51F		
13 05 80 1300	0426	.15		.12		.070	.99 51F		
21 05 80 0855	0426	.14		.088 13F	.085 46F	.085 66F	.72		.2
21 05 80 0900	0426	.15		.084	.069	.061	.68 51F	.50	.2
03 06 80 0830	0426	.22	.19	.076 03L	.073 56L	.067 56L	.64 61L	.30 10L	.5
16 06 80 1400	0426	.094	.033	.033	.022	.018	.31	.26	L.1
01 07 80 1230	0426		.059	.11		.058	.72		.2
14 07 80 0830	0426	.091	.066	.066	.058	.047	.90	.68	L.1
21 07 80 1200	0426	.13		.090		.084	.90 51F		
21 07 80 1600	0426	.14		.11		.086	.89 51F		
21 07 80 2000	0426	.15		.12		.096	.82 51F		
22 07 80 0000	0426	.15		.12		.10	.76 51F		
22 07 80 0400	0426	.18		.12		.10	.81 51F		
22 07 80 0415	0426	.16		.13		.10	.81 51F		
22 07 80 0500	0426	.15		.13		.11	.91 51F		
22 07 80 0600	0426	.15		.13		.10	1.1 51F		
22 07 80 0800	0426	.15		.12		.098	.92 51F		
22 07 80 1200	0426	.17		.14		.11	.99 51F		
28 07 80 1245	0426	.11	.10	.082	.078	.064	.94	.80	.2
11 08 80 1145	0426	.15	.17	.12	.020	.011	.91	.84	.1
25 08 80 1230	0426	.11	.11	.10	.094	.091	1.0	1.0	L.1
08 09 80 1300	0426	.13	.11	.12	.11	.11	1.2	.95	L.1
22 09 80 1215	0426	.14	.14	.12	.12	.11	1.4	1.2	.1
22 09 80 1220	0426	.15	.13	.12	.11	.097	1.5	1.2	.2
06 10 80 1200	0426	.16	.15	.15	.14	.13	1.0	.82	L.1
20 10 80 1000	0426	.13		.12		.10	1.0 51F		
20 10 80 1245	0426	.14	.14	.13	.12	.11	1.1	.82	L.1
20 10 80 1400	0426	.14		.13		.12	1.2 51F		

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
20 10 80 1800	0426	.17		.16		.15	1.3 51F		
20 10 80 2200	0426	.19		.18		.16	1.4 51F		
21 10 80 0200	0426	.19		.17		.16	1.1 51F		
21 10 80 0600	0426	.18		.16		.15	1.2 51F		
21 10 80 0615	0426	.18		.17		.16	1.1 51F		
21 10 80 0700	0426	.18		.17		.16	1.2 51F		
21 10 80 0800	0426	.18		.17		.16	1.3 51F		
21 10 80 1000	0426	.19		.18		.17	1.2 51F		
03 11 80 1216	0426	.15	.15	.14	.11	.11	1.1	.90	.2
18 11 80 1120	0426	.20	.19	.19	.18	.17	1.2	.92	.2
08 12 80 0900	0426	.30	.28	.27	.27	.27		1.2	2.4
05 01 81 1100	0426	.18	.18	.18	.17	.16	1.3	.65	.6
20 01 81 0602	0426	.19		.18		.18	1.2 51F		
20 01 81 0615	0426	.19		.19		.17	1.1 51F		
20 01 81 0700	0426	.19		.19		.18	1.1 51F		
20 01 81 0800	0426	.20		.19		.18	1.1 51F		
20 01 81 1000	0426	.22		.20		.18	1.1 51F		
20 01 81 1400	0426	.23		.20		.18	1.2 51F		
20 01 81 1800	0426	.23		.21		.20	1.1 51F		
20 01 81 2203	0426	.23		.20		.20	1.3 51F		
21 01 81 0158	0426	.20		.18		.18	1.2 51F		
21 01 81 0600	0426	.19		.18		.17	1.2 51F		
26 01 81 1100	0426	.15	.15	.14	.13	.13	1.0	.52	.7
16 02 81 1000	0426	.18	.16	.16	.16	.14		.70	.8
09 03 81 1130	0426	.22	.22	.16	.16	.16	1.4	.70	.5
18 03 81 1000	0426	.23		.19		.15	1.4 51F		
18 03 81 1400	0426	.20		.17		.14	1.5 51F		
18 03 81 1800	0426	.21		.18		.16	1.7 51F		
18 03 81 2200	0426	.24		.21		.18	1.9 51F		
19 03 81 0200	0426	.24		.21		.18	1.7 51F		
19 03 81 0600	0426	.23		.19		.17	1.5 51F		
19 03 81 0615	0426	.23		.19		.17	1.5 51F		
19 03 81 0700	0426	.24		.19		.18	1.5 51F		
19 03 81 0800	0426	.24		.20		.18	1.6 51F		
19 03 81 0940	0426	.25		.21		.20	1.7 51F		
20 03 81 1125	0426	.22	.19	.20	.19	.19	1.8	.66	1.
06 04 81 1145	0426	.19	.17	.14	.14	.14		.62	.6
21 04 81 1015	0426	.26	.22	.23	.20	.20	1.9	.78	1.0
04 05 81 1030	0426	.25	.22	.22	.18	.18	1.8	1.5	.3

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
19 05 81 1145	0426	.19	.16	.054	.044	.034	.63	.30	.1
19 05 81 1150	0426	.20	.15	.054	.046	.038	.67	.30	.2
09 06 81 1225	0426	.085	.076	.045	.039	.033	.88	.28	.3
30 06 81 1000	0426	.059	.058	.040	.032	.022	.51	.37	L.1
20 07 81 1130	0426	.062	.050	.030	.027	.019	.38	.31	L.1
08 08 81 1515	0426	.053	.046	.030	.023	.022	.55	.44	L.1
24 08 81 1245	0426	.079	.070	.063	.059	.047		.50	.1
21 09 81 0800	0426	.13	.11	.12	.11	.10	1.5	1.5	L.1
14 10 81 1630	0426	.24	.21	.23	.21	.21	1.9	1.2	.5
02 11 81 1030	0426	.15	.14	.14	.13	.13	1.5	1.3	.5
23 11 81 1030	0426	.11	.083	.072	.065	.058	1.5	1.0	.3
16 12 81 1130	0426	.27	.26	.26	.25	.25	1.9	.90	.9
08 01 82 1500	0426	.31	.29	.29	.29	.28	2.2	1.0	.9
01 02 82 0930	0426	.24	.24	.23	.23	.22	2.0	1.2	
24 02 82 1000	0426	.28	.26	.26	.24	.24	1.7	1.1	
15 03 82 1100	0426	.32	.29	.24	.24	.22	1.7	1.3	
04 04 82 1600	0426	.25	.24	.22	.22	.22	1.8	1.2	
28 04 82 1020	0426	.14	.13	.10	.092	.092	.79	.49	

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
15 05 79 0905	0426	11.0	10.2	7.	2.	.11		
15 05 79 0945	0426	11.0	10.2	7.	L1.	.12		
29 05 79 0615	0426	10.	32.	48.	42.	.27		
29 05 79 0645	0426	10.	35.	51.	45.	.27		
12 06 79 0700	0426	14.5	2.3	L1.	L1.	.06		
12 06 79 0725	0426	14.5	2.6	4.	1.	.08		
26 06 79 0615	0426	15.5	4.7	2.	L1.	.09		
26 06 79 0635	0426	15.5	5.0	5.	L1.	.08		
09 07 79 0715	0426	17.5	4.8	13.	10.	.21		
09 07 79 0730	0426	17.5	4.7	7.	2.			
23 07 79 0650	0426	18.5		L1.	L1.	.08		

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
23 07 79 0705	0426	18.5		3.	3.			
05 08 79 1025	0426	17.	1.7	11.7	9.6	.05		
05 08 79 1040	0426	17.	1.5	L1.	1.7			
21 08 79 0825	0426	17.	.5	L1.	L1.	.08		
21 08 79 0830	0426	17.	.7	4.3	3.6			
24 09 79 0640	0426	12.	1.9	4.	3.	.12		
24 09 79 0645	0426	12.	2.0	1.	L1.			
09 10 79 0640	0426	7.	1.9	3.	3.	.09		
09 10 79 0645	0426	7.	2.1	5.	4.			
29 10 79 0755	0426	3.	1.0	14.	11.	.11		
29 10 79 0800	0426	3.	2.5	11.	8.			
19 11 79 0725	0426	0.	.9	3.	L1.	.09 02L		
19 11 79 0730	0426	0.	.6	2.	L1.			
10 12 79 0755	0426	0.	6.0	3.	2.	.12 02L		
10 12 79 0800	0426	0.	1.0	5.	3.			
07 01 80 1125	0426	1.	1.0	2.	L1.	.05 02L	.32 02L	2. 06L
07 01 80 1130	0426	1.	1.0	2.	L1.			5. 04L
28 01 80 0825	0426	0.	1.3	L1.	L1.	.04 02L	.28 02L	1. 06L
28 01 80 0830	0426	0.	1.6	L1.	L1.			1. 04L
18 02 80 0825	0426	0.	1.2	10.	7.	.10 02L	.62 02L	1. 06L
18 02 80 0830	0426	0.	1.9	9.	8.			1.
10 03 80 0955	0426	0.	1.5	14.	11.	.11 02L	1.0 02L	1. 06L
10 03 80 1000	0426	0.	2.2	13.	10.			1. 04L
24 03 80 0855	0426	0.	3.6	12.	10.	.24 02L	1.8 02L	3. 06L
24 03 80 0900	0426	0.	3.2	16.	14.			2. 04L
08 04 80 0825	0426	1. 61F	5.2	16.	13.	.05 02L	1.3 02L	5. 06L
08 04 80 0830	0426	1. 61F	4.0	21.	16.			5. 04L
21 04 80 0825	0426		.6	22.	19.	.18 02L	1.2 02L	3. 06L
21 04 80 0830	0426		.3	22.	19.			3. 04L
05 05 80 1315	0426	13. 61F	5.7	19.	15.	.19	1.0	2. 06F
05 05 80 1320	0426	13. 61F	5.5	18.	14.			2.
12 05 80 1300	0426	13.0 61F						
12 05 80 1700	0426	13.5 61F						
12 05 80 2100	0426	13.0 61F						
13 05 80 0100	0426	12.5 61F						
13 05 80 0500	0426	12.0 61F						
13 05 80 0515	0426	12.0 61F						
13 05 80 0600	0426	11.5 61F						
13 05 80 0700	0426	11.5 61F						

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                                                          NAQUADAT DETAILED REPORT
                                                       PARTICULATES TEMP DOC

STATION 00AT05BM2215     LAT. 50D 49M 56S  LONG. 133D 24M 46S   PR 3   UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR                  UPSTREAM OF HIGHWAY #24


                                02061S       02073L      10401L       10501L      07902F       06902F        06104F
                              TEMPERATURE   TURBIDITY    RESIDUE      RESIDUE     NITROGEN     CARBON        CARBON
                                  OF                    NONFILTR.      FIXED     PARTICUL.    ORGANIC       DISSOLVED
   SAMPLE DATE                  WATER                               NONFILTR.                 PARTICULATE    ORGANIC
       MST           SUBM                                                            N            C             C
  D  M  Y  HR         ID       DEG.C.         JTU         MG/L         MG/L        MG/L         MG/L          MG/L

 13 05 80 0900      0426       12.0 61F
 13 05 80 1300      0426       13.2 61F
 21 05 80 0855      0426       15.  61F       2.5         15.          13.          .18          .90           2. 06F
 21 05 80 0900      0426       15.  61F       2.5         13.          12.                                     2.
 03 06 80 0830      0426                     32.0         39.0         35.0         .13 02L     1.0  02L       3. 04L

 16 06 80 1400      0426       17.  61F      19.          55.0         51.0         .15          .86           2.
 01 07 80 1230      0426       15.  61F       2.2          7.0          6.0         .10          .48           1.
 14 07 80 0830      0426                      1.5          4.           4.          .14          .84           2.
 21 07 80 1200      0426       19.2 61F
 21 07 80 1600      0426       21.0 61F

 21 07 80 2000      0426       20.7 61F
 22 07 80 0000      0426       20.0 61F
 22 07 80 0400      0426       19.4 61F
 22 07 80 0415      0426       19.1 61F
 22 07 80 0500      0426       19.0 61F

 22 07 80 0600      0426       19.0 61F
 22 07 80 0800      0426       19.0 61F
 22 07 80 1200      0426       20.7 61F
 28 07 80 1245      0426       20.0 61F       4.0          9.           6.          .17          .92           1.
 11 08 80 1145      0426       16.0 61F       4.2         17.          15.          .12          .83           2.

 25 08 80 1230      0426       14.  61F       1.9          2.           1.          .07          .23           1.
 08 09 80 1300      0426       15.  61F       1.5          2.           1.          .09          .50           1.
 22 09 80 1215      0426       12.  61F       1.4          4.           3.          .08          .43           1.
 22 09 80 1220      0426       12.  61F       1.1          7.           4.                                     2.
 06 10 80 1200      0426       16.  61F        .7          2.           1.          .04          .23

 20 10 80 1000      0426        7.0 61F
 20 10 80 1245      0426        8.  61F       3.7          9.           6.          .04          .43           1.
 20 10 80 1400      0426        8.0 61F
 20 10 80 1800      0426        7.5 61F
 20 10 80 2200      0426        7.0 61F

 21 10 80 0200      0426        7.0 61F
 21 10 80 0600      0426        6.0 61F
 21 10 80 0615      0426        6.0 61F
 21 10 80 0700      0426        6.0 61F
 21 10 80 0800      0426        6.0 61F

 21 10 80 1000      0426        6.0 61F
 03 11 80 1216      0426        0.  61F       7.3          3.           2.          .11          .44           1.
 18 11 80 1120      0426                      1.3          3.           1.          .04          .20           1.
 08 12 80 0900      0426         .0 61F       1.2          1.          L1.          .03          .11           2.
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                                                NAQUADAT DETAILED REPORT
                                             PARTICULATES TEMP DOC

STATION 00AT05BM2215    LAT. 50D 49M 56S  LONG. 133D 24M 46S   PR 3   UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR              UPSTREAM OF HIGHWAY #24

                             02061S       02073L        10401L        10501L       07902F       06902F       06104F
                           TEMPERATURE   TURBIDITY      RESIDUE       RESIDUE      NITROGEN     CARBON       CARBON
                               OF                      NONFILTR.       FIXED      PARTICUL.    ORGANIC     DISSOLVED
   SAMPLE DATE                WATER                                  NONFILTR.               PARTICULATE    ORGANIC
       MST          SUBM                                                              N            C            C
 D  M  Y  HR         ID       DEG.C.       JTU           MG/L          MG/L          MG/L         MG/L         MG/L

05 01 81 1100       0426       0.  61F      2.1           3.            2.           .06          .32          2.
20 01 81 0602       0426       2.  61F
20 01 81 0615       0426       0.  61F
20 01 81 0700       0426       0.  61F
20 01 81 0800       0426       0.  61F

20 01 81 1000       0426       0.  61F
20 01 81 1400       0426       3.  61F
20 01 81 1800       0426       2.  61F
20 01 81 2203       0426       0.  61F
21 01 81 0158       0426       0.  61F

21 01 81 0600       0426       0.  61F
26 01 81 1100       0426                    2.5           9.            8.           .87          .51          2.
16 02 81 1000       0426                    1.8           4.            2.           .05          .32          2.
09 03 81 1130       0426                    4.3          19.           16.           .23         1.4           1.
18 03 81 1000       0426       1.0 61F

18 03 81 1400       0426       2.0 61F
18 03 81 1800       0426       3.0 61F
18 03 81 2200       0426       3.0 61F
19 03 81 0200       0426       2.0 61F
19 03 81 0600       0426       2.0 61F

19 03 81 0615       0426       2.0 61F
19 03 81 0700       0426       1.0 61F
19 03 81 0800       0426       1.0 61F
19 03 81 0940       0426       1.0 61F
20 03 81 1125       0426                    2.4           5.            3.           .11          .71          2.

06 04 81 1145       0426       5.0 61F      2.9           7.            6.           .14          .54          2.
21 04 81 1015       0426       8.0 61F      2.0           5.            3.           .18          .79          2.
04 05 81 1030       0426       9.0 61F      5.2          10.            8.           .14          .84          3.
19 05 81 1145       0426      11.0 61F     74.          184.          167.           .39         2.9           6.
19 05 81 1150       0426      11.0 61F     78.          183.          166.           .33         2.2           6.

09 06 81 1225       0426      12.0 61F     18.           27.           21.           .10          .80          3.
30 06 81 1000       0426      13.0 61F      4.4           8.            7.           .07          .50          3.
20 07 81 1130       0426      14.  61F     18.           28.                         .12          .87          2.
08 08 81 1515       0426      17.  61F      4.3           7.            5.           .07          .40          2.
24 08 81 1245       0426      17.  61F      2.0           6.            3.           .07          .42          1.

21 09 81 0800       0426      12.  61F      2.2           5.            4.           .09          .46          2.
14 10 81 1630       0426       8.  61F      1.2           1.            1.           .08          .39          2.
02 11 81 1030       0426       9.  61F      1.1           1.           L1.           .08          .52          2.
23 11 81 1030       0426                    1.5           1.            1.           .10          .43          2.
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NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
16 12 81 1130	0426	.0 61F	1.6	3.0	1.0	.05	.26	2.
08 01 82 1500	0426	.0 61F	.9	1.	L1.	L.01	.18	2.
01 02 82 0930	0426	.0 61F	1.4	3.	1.	.07	.18	2.
24 02 82 1000	0426	.0 61F	1.4	3.	2.	.09		2.
15 03 82 1100	0426	7.0 61F	4.8	9.	6.	.23	1.4	3.
04 04 82 1600	0426	.0 61F	1.7	6.	4.	.10	.62	3.
28 04 82 1020	0426	5.0 61F	3.8	5.	4.	.13	.82	2.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
15 05 79 0905	0426			128.		363.		
15 05 79 0945	0426			132.		364.		
29 05 79 0615	0426	7.8		113.	.0	319.		
29 05 79 0645	0426	7.8		113.	.0	317.		
12 06 79 0700	0426	8.0		109.	.0	303.		
12 06 79 0725	0426	8.0		108.	.0	303.		
26 06 79 0615	0426	7.9		110.	.0	294.		
26 06 79 0635	0426	7.8		110.	.0	311.		
09 07 79 0715	0426	8.3		101.	.0	284.		
09 07 79 0730	0426	8.3		103.	.0	292.		
23 07 79 0650	0426			96.	.0	282.		
23 07 79 0705	0426	8.3		97.	.0	280.		
05 08 79 1025	0426	8.7		97.	13.	289.		
05 08 79 1040	0426	8.7		100.	14.	278.		
21 08 79 0825	0426	8.4		103.		311.		
21 08 79 0830	0426	8.4		105.		313.		
24 09 79 0640	0426	7.9		87.	.0	277.		
24 09 79 0645	0426	8.1		116.	.0	343.		
09 10 79 0640	0426	8.0		129.	.0	364.		
09 10 79 0645	0426	8.0		131.	.0	359.		
29 10 79 0755	0426	8.0		129.	.0	405.		

NAQUADAT DETAILED REPORT

PH DIC ALK COND CL SIO2

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
29 10 79 0800	0426	7.9		130.	.0	403.		
19 11 79 0725	0426	7.9		132.	.0	413.		
19 11 79 0730	0426	7.9		130.	.0	415.		
10 12 79 0755	0426	7.9		112.	.0	438.		
10 12 79 0800	0426	7.9		112.	.0	440.		
07 01 80 1125	0426	7.6	39. 53L	158.	.0	491.		4.9
07 01 80 1130	0426	7.5	39. 52L	159.	.0	491.		4.9
28 01 80 0825	0426	7.6	35. 53L	147.	.0	464.		4.5
28 01 80 0830	0426	7.6	35. 52L	144.	.0	462.		4.6
18 02 80 0825	0426	7.6	28. 53L	111.	.0	455.		4.4
18 02 80 0830	0426	7.7	29. 52L	111.	.0	429.		4.3
10 03 80 0955	0426	7.7	26. 53L	133.	.0	442.		4.2
10 03 80 1000	0426	7.7	26. 52L	128.	.0	431.		4.3
24 03 80 0855	0426	7.8	23. 53L	120.	.0	430.		3.7
24 03 80 0900	0426	7.7	23. 52L	110.	.0	436.		3.8
08 04 80 0825	0426	7.6	21. 53L	130. 01L	.0	377.	5.6	4.0
08 04 80 0830	0426	7.7	22. 52L	130. 01L	.0	382.	5.5	3.9
21 04 80 0825	0426	7.6	26. 53L	120. 01L	0.	355.	3.8	3.5
21 04 80 0830	0426	7.6	28. 52L	130. 01L	0.	360.	3.9	3.3
05 05 80 1315	0426	8.1	24. 53F	130. 01L	0.	316.	3.6	2.4
05 05 80 1320	0426	8.2	24.	120. 01L	0.	323.	3.6	2.6
21 05 80 0855	0426	7.7	23. 53F	111. 01L	0.	316.	3.1	1.8
21 05 80 0900	0426	7.9	24.	112. 01L	0.	315.	3.1	2.0
03 06 80 0830	0426	8.0	23. 52L	116. 01L	.0	316.	2.9	3.6
16 06 80 1400	0426	8.1	23.	114. 01L	.0	303.	1.4	4.2
01 07 80 1230	0426	8.1	23.	119. 01L	.0	324.	2.8	3.3
14 07 80 0830	0426	8.3	26.	120. 01L	.0	339.	3.5	.6
28 07 80 1245	0426	8.1	24.	113. 01L	.0	326.	3.3	2.8
11 08 80 1145	0426	8.0	25.	119. 01L	.0	333.	3.5	2.9
25 08 80 1230	0426	8.5	25.	120. 01L	.0	347.	3.8	3.6
08 09 80 1300	0426	8.7	23.	118. 01L	.0	342.	4.1	2.5
22 09 80 1215	0426	8.5	29.	126. 01L	.1	364.	3.7	2.6
22 09 80 1220	0426	8.4	29.	127. 01L	.0	365.	3.8	2.5
06 10 80 1200	0426	8.4	28.	127. 01L	.0	369.	4.2	1.0
20 10 80 1000	0426	8.0				367.		
20 10 80 1245	0426	8.0	29.	125. 01L	.0	371.	3.9	2.0
20 10 80 1400	0426	8.1				374.		
20 10 80 1800	0426	8.3				370.		
20 10 80 2200	0426	8.4				366.		

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
21 10 80 0200	0426	8.3				369.		
21 10 80 0600	0426	8.2				369.		
21 10 80 0615	0426	8.2				370.		
21 10 80 0700	0426	8.1				372.		
21 10 80 0800	0426	8.2				374.		
21 10 80 1000	0426	8.1				377.		
03 11 80 1216	0426	8.1	34.	130. 01L	.0	386.	4.4	2.7
18 11 80 1120	0426	8.0	32.	137. 01L	.0	401.	5.2	2.9
08 12 80 0900	0426	7.8	36.	162. 01L	.0	481.	7.8	4.6
05 01 81 1100	0426	7.8	27.	140. 01L	.0	413.	4.8	4.1
20 01 81 0602	0426	8.0				394.		
20 01 81 0615	0426	8.0				391.		
20 01 81 0700	0426	7.8				392.		
20 01 81 0800	0426	7.8				395.		
20 01 81 1000	0426	7.7				399.		
20 01 81 1400	0426	7.7				407.		
20 01 81 1800	0426	8.0				408.		
20 01 81 2203	0426	7.9				409.		
21 01 81 0158	0426	7.9				402.		
21 01 81 0600	0426	7.9				394.		
26 01 81 1100	0426	8.0	35.	128. 01L	.0	384.	4.9	3.7
16 02 81 1000	0426	7.8	33.	129. 01L	.0	403.	7.9	3.3
09 03 81 1130	0426	8.0	38.	124. 01L	.0	389.	5.5	2.9
18 03 81 1000	0426	8.3				401.		
18 03 81 1400	0426	8.3				408.		
18 03 81 1800	0426	8.5				403.		
18 03 81 2200	0426	8.7				400.		
19 03 81 0200	0426	8.7				390.		
19 03 81 0600	0426	8.6				390.		
19 03 81 0615	0426	8.6				387.		
19 03 81 0700	0426	8.5				394.		
19 03 81 0800	0426	8.5				395.		
19 03 81 0940	0426	8.3				401.		
20 03 81 1125	0426	8.1	41.	135. 01L	.0	404.	6.1	2.3
06 04 81 1145	0426	8.1	32.	129. 01L	.0	392.	4.8	2.6
21 04 81 1015	0426	7.9	31.	131. 01L	.0	413.	5.3	2.9
04 05 81 1030	0426	7.8	34.	136. 01L	.0	400.	5.2	2.5
19 05 81 1145	0426	8.0	32.	134. 01L	.0	370.	2.7	5.7
19 05 81 1150	0426	8.0	32.	133. 01L	.0	376.	2.7	5.6

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
09	06	81	1225	0426	8.1	29.	121. 01L	.0	307.	2.2	4.9
30	06	81	1000	0426	8.3	30.	129. 01L	.0	334.	2.7	3.5
20	07	81	1130	0426	8.1	29.	114. 01L	.0	295.	1.8	3.3
08	08	81	1515	0426	8.2	30.	123. 01L	.0	320.	2.1	4.0
24	08	81	1245	0426	8.3	29.	122. 01L	.0	316.	2.1	3.5
21	09	81	0800	0426	8.0	29.	124. 01L	.0	349.	4.8	2.2
14	10	81	1630	0426	8.5	28.	135. 01L	1.5	374.	6.3	1.8
02	11	81	1030	0426	7.8	32.	136. 01L	.0	388.	5.2	.4
23	11	81	1030	0426	7.8	25.	141. 01L	.0	386.	7.7	2.0
16	12	81	1130	0426	7.8	38.	155. 01L	.0	421.	7.0	3.5
08	01	82	1500	0426	7.6	37.	164. 01L	.0	446.	7.6	4.6
01	02	82	0930	0426	7.6	33.	150. 01L	.0	400.	6.4	4.4
24	02	82	1000	0426	7.7	38.	140. 01L	.0	395.	8.2	4.3
15	03	82	1100	0426	7.7	31.	140. 01L	.0	395.	12.	4.0
04	04	82	1600	0426	7.7	35.	145. 01L	.0	406.	9.4	3.8
28	04	82	1020	0426	8.0	24.	130. 01L	.0	341.	6.6	2.2

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
15 05 79 1230	0426	.098	.088	.070 13F	.068 46F	.040 66F	.73	.43 19F	.1
15 05 79 1300	0426	.10	.086	.078	.064	.057	.72 51F	.42	.1
29 05 79 0910	0426	.16	.14	.051 13F	.035 46F	.039 66F	.47	.31 19F	.1
29 05 79 0945	0426	.16	.14	.048	.042	.04	.47 51F	.32	.1
04 06 79 0815	0426	.13	.083			.064 66F	.79	.50 19F	.2
04 06 79 0845	0426	.124	.099	.081	.063	.064	.79 51F	.50	.2
12 06 79 0940	0426	.063	.049	.046 13F	.033 46F	.031 66F	.37	.24 19F	L.1
12 06 79 1015	0426	.065	.048	.046	.035	.031	.36 51F	.23	L.1
26 06 79 0930	0426	.075	.071	.050 13F	.047 46F	.045 66F	.35	.18 19F	L.1
26 06 79 0950	0426	.072	.069	.050	.049	.040	.33 51F	.18	L.1
04 07 79 0800	0426	.072	.057	.049 13F	.040 46F	.034 66F	.44	.22 19F	L.1
04 07 79 0820	0426	.069	.061	.050	.035		.54 51F	.23	L.1
10 07 79 0730	0426		.047	.074 13F	.07 46F	.065 66F	.65	.42 19F	.1
10 07 79 0750	0426			.067	.067	.061	.87 51F	.45	.1
24 07 79 0830	0426	.16	.15	.15 13F	.13 46F	.12 66F	.50	.32 19F	.2
24 07 79 0845	0426	.16	.13	.15	.13	.12		.35	.6
30 07 79 1030	0426	.089	.071	.083 13F	.063 46F	.065 66F	.44	.29 19F	.2
30 07 79 1045	0426	.094	.070	.08	.071	.068	.47 51F	.11	.2
06 08 79 0755	0426	.11	.075	.085 13F	.054 46F	.044 66F	.61	.44 19F	L.1
06 08 79 0810	0426	.10	.075	.082	.068	.059	.52 51F	.41	L.1
21 08 79 1025	0426	.12	.082	.083 13F	.065 46F	.061 66F	.36	.07 19F	L.1
21 08 79 1040	0426	.12	.081	.092	.065	.062	.38 51F	.08	L.1
24 09 79 1015	0426	.13	.11	.12 13F	.11 46F	.10 66F	.88	.73 19F	L.1
24 09 79 1020	0426	.13	.12	.11	.10	.10	.90 51F	.63	L.1
09 10 79 1015	0426	.15	.13	.14 13F	.13 46F	.12 66F	1.4	1.3 19F	L.1
09 10 79 1020	0426	.15	.14	.14	.13	.12	1.4 51F	1.3	L.1
29 10 79 1055	0426	.17	.15	.15 13F	.13 46F	.12 66F		1.3 19F	L.1
29 10 79 1100	0426	.17	.16	.14	.13	.12	1.7 51F	1.3	L.1
19 11 79 1025	0426	.18	.16	.17 13L	.15 46L	.15 66L	1.8 61L	1.5 19L	.1
19 11 79 1030	0426	.18	.16	.16 03L	.15 56L	.14 56L	1.8 51L	1.5 10L	.1
10 12 79 1155	0426	.27	.25	.25 13L	.24 46L	.24 66L	2.7 61L	1.6 19L	1.0
10 12 79 1200	0426	.26	.25	.25 03L	.24 56L	.24 56L	2.6 51L	1.6 10L	.8
08 01 80 0925	0426	.23	.23	.22 13L	.21 46L	.20 66L	2.0 61L	1.3 19L	.8
08 01 80 0930	0426	.23	.22	.21 03L	.21 56L	.19 56L	2.1 51L	1.4 10L	.8
29 01 80 0825	0426	.22	.22	.20 13L	.20 46L	.20 66L	2.0 61L	1.0 19L	.9
29 01 80 0830	0426	.23	.21	.19 03L	.19 56L	.19 56L	1.9 51L	1.3 10L	.9
19 02 80 0835	0426	.22	.22	.21 13L		.19 66L	1.7 61L	1.2 19L	
19 02 80 0840	0426	.22	.21	.21 03L	.20 56L	.20 56L	1.8 51L	1.2 10L	.9
11 03 80 0825	0426	.24	.23	.21 13L	.20 46L	.20 66L	1.8 61L	1.0 19L	.7

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                                                    NAQUADAT DETAILED REPORT
                                                PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2240    LAT. 50D 44M 52S  LONG. 112D 31M 27S   PR 3   UTM 12 392500E 5622650N
 BOW RIVER BELOW BASSANO DAM

                             15406L      15301L      15103F      15356F      15256F      07661F      07110F      07506L
                           PHOSPHOROUS PHOSPHORUS  PHOSPHORUS  PHOSPHORUS  PHOSPHORUS   NITROGEN    NITROGEN    NITROGEN
                              TOTAL       TOTAL     DISSOLVED   DISSOLVED   DISSOLVED   DISSOLVED   DISSOLVED     TOTAL
  SAMPLE DATE               PHOSPHATE   INORGANIC               INORG. PO4  ORTHO PO4      N        NO3 & NO2    AMMONIA
     MST           SUBM         P           P           P           P           P                       N           N
 D  M  Y  HR        ID         MG/L        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L

11 03 80 0830     0426        .24         .23         .21  03L    .20  56L    .20  56L   1.8  51L    1.2  10L       .7
25 03 80 1410     0426        .30         .27         .24  13L    .22  46L    .21  66L   2.1  61L     .94 19L      1.0
25 03 80 1415     0426        .33         .30         .23  03L    .23  56L    .20  56L   2.1  51L     .96 10L
09 04 80 0825     0426        .23         .18         .14  13L    .13  46L    .11  66L   1.3  61L     .58 19L       .8
09 04 80 0830     0426        .27         .24         .13  03L    .11  56L    .10  56L   1.6  51L     .62 10L       .8

22 04 80 0855     0426        .26         .23         .13  13F    .11  46F    .10  66F   1.0          .54 19F       .4
22 04 80 0900     0426        .25         .21         .12         .088        .088         .91 51F     .60          .4
05 05 80 1705     0426        .12         .10         .094 13F    .089 46F    .089 66F     .58         .41 19F      L.1
05 05 80 1710     0426        .13         .11         .088                    .071         .56 51F     .40         L.1
21 05 80 1225     0426        .098                    .076 13F    .059 46F    .055 66F     .25         .10 19F      L.1

21 05 80 1230     0426        .11                     .073        .064        .052         .26 51F     .07          .1
03 06 80 1130     0426        .098        .084        .044 03L    .038 56L    .037 56L     .62 61L     .37 10L      .2
17 06 80 0910     0426        .13         .086        .029        .017        .017         .41         .33         L.1
02 07 80 0900     0426        .059        .011        .011        .003       L.003         .57         .46         L.1
14 07 80 1400     0426        .067        .049        .046 03L    .037 56L    .034 56L     .65 61L     .43 10L     L.1

15 07 80 0900     0426        .063        .049        .042        .034        .029         .66         .47         L.1
29 07 80 1100     0426        .13         .12                     .095        .078         .58         .45          .1
12 08 80 0915     0426        .13         .15         .11         .11         .095         .65         .54         L.1
26 08 80 1115     0426        .080        .067        .057        .056        .047         .76         .68          .1
07 09 80 1305     0426        .094        .087        .074 03L    .068 56L    .066 56L     .48 61L     .31 10L     L.1

09 09 80 1000     0426        .088        .076        .072        .060        .052         .40         .25         L.1
23 09 80 1000     0426        .12         .11         .097        .088        .085         .99         .84         L.1
07 10 80 1000     0426        .11         .10         .097        .067                     .61         .45         L.1
21 10 80 1100     0426        .18         .17         .10         .084        .084       1.1           .96          .1
04 11 80 1048     0426        .16         .15         .12         .097        .097       1.0           .88         L.1

18 11 80 1310     0426        .21         .17         .12         .12         .11        1.1           .88          .2
09 12 80 0900     0426        .30         .29         .27         .27         .27                    1.1          2.4
06 01 81 0900     0426        .18         .18         .15         .15         .15        1.3           .70          .6
27 01 81 1000     0426        .18         .16         .14         .12         .12        1.1           .63          .5
17 02 81 0900     0426        .18         .17         .16         .14         .12                     .85          .8

10 03 81 0800     0426        .19         .19         .15         .15         .15        1.4          1.0           .4
10 03 81 0830     0426        .17         .17         .15         .15         .15        1.4           .95          .3
21 03 81 1213     0426        .45         .18         .16         .15         .15        1.4           .78          .6
07 04 81 1100     0426        .19         .18         .12         .12         .11        1.1           .72          .3
22 04 81 0800     0426        .22                     .16         .14         .14        1.1           .80          .2

05 05 81 0800     0426        .28         .26         .23         .19         .17        1.9          1.6          L.1
20 05 81 0900     0426        .11         .095        .044        .034        .031         .64         .39          .1
07 06 81 1300     0426        .12         .11         .034        .028        .021         .44         .26          .1
01 07 81 0820     0426        .034        .025        .014        .009        .006         .27         .18         L.1
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NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
06 07 81 1255	0426	.024	.016	.005	.004	.003	.22	.13	L.1
21 07 81 0930	0426	.056	.054	.025	.023	.017	.40	.32	L.1
08 08 81 1320	0426	.063	.052	.030	.023	.020	.63	.52	L.1
25 08 81 0900	0426	.062	.061	.046	.043	.039	.37	.30	L.1
31 08 81 1230	0426	.089	.079	.069	.065	.058	.64	.56	L.1
22 09 81 0930	0426	.088	.049	.057	.043	.043	.94	.74	L.1
14 10 81 0930	0426	.14	.13	.12	.12	.11	1.4	1.2	L.1
03 11 81 0950	0426	.47	.46	.046	.042	.037		1.2	.7
24 11 81 1000	0426	.16	.15	.14	.13	.13	1.3	1.2	.4
16 12 81 1040	0426	.22	.21	.20	.20	.20	1.9	1.2	.9
08 01 82 1730	0426	.30	.30	.29	.27	.27	2.3	1.3	1.0
08 01 82 1735	0426	.30	.30	.29	.29	.28	2.5	1.6	
02 02 82 1000	0426	.22	.22	.20	.20	.20	2.1	1.3	
22 02 82 0930	0426	.25	.23	.23	.21	.21	2.2	1.5	.7
16 03 82 1000	0426	.34	.27	.27	.26	.23	1.8	1.5	
04 04 82 1415	0426	.26	.25	.23	.23	.23	1.9	1.5	.6
26 04 82 0720	0426	.38	.34	.085	.076	.058	.81	.52	.4

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
15 05 79 1230	0426	15.	9.4	3.	L1.	.10		
15 05 79 1300	0426	15.	8.5	3.	L1.	.10		
29 05 79 0910	0426	13.	51.	78.	70.	.34		
29 05 79 0945	0426	13.	53.	82.	73.	.34		
04 06 79 0815	0426	16.5	6.8	4.	2.	.06		
04 06 79 0845	0426	16.5	6.6	12.	8.	.08		
12 06 79 0940	0426	17.5	3.7	2.	L1.	.04		
12 06 79 1015	0426	17.5	4.3	2.	1.	.17		
26 06 79 0930	0426	18.5	7.5	3.	L1.	.08		
26 06 79 0950	0426	18.5	6.0	3.	L1.	.06		
04 07 79 0800	0426	17.5		3.	1.	.14		

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
04 07 79 0820	0426	17.5		3.	1.			
10 07 79 0730	0426	20.	2.8	3.	1.	.23		
10 07 79 0750	0426	20.5	2.7	L1.	L1.			
24 07 79 0830	0426	19.5		L1.	L1.	.07		
24 07 79 0845	0426	19.5		1.	L1.			
30 07 79 1030	0426	20.5	.7	2.2	1.2	.04		
30 07 79 1045	0426	20.5	.6	13.1	10.3			
06 08 79 0755	0426	17.5	1.2	8.4	6.7	.16		
06 08 79 0810	0426	17.5	1.3	L1.	L1.			
21 08 79 1025	0426	20.5	.8	L1.	L1.	.08		
21 08 79 1040	0426	20.5	.6	4.8	2.8			
24 09 79 1015	0426	14.	2.0	4.	2.	.09		
24 09 79 1020	0426	14.	2.7	4.	3.			
09 10 79 1015	0426	10.	2.8	7.	6.	.08		
09 10 79 1020	0426	10.	2.9	4.	3.			
29 10 79 1055	0426	6.	6.5	20.	17.	.12		
29 10 79 1100	0426	6.	4.5	4.	2.			
19 11 79 1025	0426	0.	3.5	10.	7.	.08 02L		
19 11 79 1030	0426	0.	1.5	6.	4.			
10 12 79 1155	0426	0.	2.6	2.	1.	.06 02L		
10 12 79 1200	0426	0.	3.7	3.	2.			
08 01 80 0925	0426	1.	5.3	3.	2.	.05 02L	.27 02L	3. 06L
08 01 80 0930	0426	1.	1.8	2.	L1.			5. 04L
29 01 80 0825	0426	0.	4.1	6.	4.	.06 02L	.35 02L	1. 06L
29 01 80 0830	0426	0.	4.4	4.	L1.			1. 04L
19 02 80 0835	0426	0.	2.4	10.	9.	.07 02L	.61 02L	1. 06L
19 02 80 0840	0426	0.	3.3	11.	9.			1.
11 03 80 0825	0426	0.	5.5	12.	10.	.10 02L	.78 02L	1. 06L
11 03 80 0830	0426	0.	5.3	13.	11.			1. 04L
25 03 80 1410	0426	1.	16.	28.	26.	.22 02L	1.4 02L	4. 06L
25 03 80 1415	0426	1.	17.	20.	16.			3. 04L
09 04 80 0825	0426	1. 61F	38.	39.	35.	.03 02L	3.6 02L	7. 06L
09 04 80 0830	0426	1. 61F	41.	46.	40.			7. 04L
22 04 80 0855	0426	7. 61F	.9	80.	69.	.43	3.3	3. 06F
22 04 80 0900	0426	7. 61F	1.2	70.	63.			3.
05 05 80 1705	0426	15. 61F	4.4	7.	5.	.12	.47	2. 06F
05 05 80 1710	0426	15. 61F	4.4	5.	3.			2.
21 05 80 1225	0426	19. 61F	1.7	2.	2.	.14	.63	2. 06F
21 05 80 1230	0426	19. 61F	2.0	4.	4.			2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST	SUBM	02061S TEMPERATURE OF WATER	02073L TURBIDITY	10401L RESIDUE NONFILTR.	10501L RESIDUE FIXED NONFILTR.	07902F NITROGEN PARTICUL.	06902F CARBON ORGANIC PARTICULATE	06104F CARBON DISSOLVED ORGANIC
D M Y HR	ID	DEG.C.	JTU	MG/L	MG/L	N MG/L	C MG/L	C MG/L
03 06 80 1130	0426	12. 61F	17.0	37.0	34.0	.09 02L	.48 02L	3. 04L
17 06 80 0910	0426	18. 61F	26.	62.	56.	.18	1.8	2.
02 07 80 0900	0426	15. 61F	3.1	7.0	6.0	.07	.35	2.
14 07 80 1400	0426	19.0 61F		6.	5.	.14 02L	.67 02L	2. 04L
15 07 80 0900	0426		3.2	4.	3.	.09	.52	2.
29 07 80 1100	0426	22.0 61F	5.2	9.	7.	.13	.56	1.
12 08 80 0915	0426	17.0 61F	3.6	L1.	L1.	.17	.42	2.
26 08 80 1115	0426	16. 61F	3.5	4.	2.	.08	.33	2.
07 09 80 1305	0426	16.7 61F		9.	6.	.10 02L	.45 02L	2. 04L
09 09 80 1000	0426	17. 61F	3.8	7.	5.	.07	.42	2.
23 09 80 1000	0426	12. 61F	3.7	4.	3.	.10	.92	2.
07 10 80 1000	0426	15. 61F	3.5	3.	2.	.05	.41	
21 10 80 1100	0426	8.5 61F	24.	64.	58.	.19	1.6	2.
04 11 80 1048	0426	0. 61F	7.3	26.	22.	.16	1.3	1.
18 11 80 1310	0426		17.	52.	45.	.16	1.2	1.
09 12 80 0900	0426	.0 61F	2.7	3.	3.	.07	.38	2.
06 01 81 0900	0426	0. 61F	2.9	8.	6.	.05	.39	2.
27 01 81 1000	0426		6.4	37.	32.	.11	.77	2.
17 02 81 0900	0426		5.2	14.	11.	.07	.74	2.
10 03 81 0800	0426		4.7	13.	11.	.09	.69	2.
10 03 81 0830	0426		4.3	13.	11.	.09	.80	2.
21 03 81 1213	0426		16.0	59.	56.	.17	1.6	2.
07 04 81 1100	0426	5.0 61F	16.0	33.	29.	.21	1.4	2.
22 04 81 0800	0426	9.0 61F	8.0	26.	23.	.17	.88	2.
05 05 81 0800	0426	9.0 61F	17.0	33.	28.	.20	1.4	3.
20 05 81 0900	0426	13.0 61F	36.	51.	45.	.22	1.4	6.
07 06 81 1300	0426	13.0 61F	40.	70.	63.	.18	1.9	3.
01 07 81 0820	0426	15.0 61F	4.3	4.	2.	.07	.34	3.
06 07 81 1255	0426	19.5 61F		6.	4.	.06	.27	2.
21 07 81 0930	0426	17. 61F	25.	40.		.12	.92	2.
08 08 81 1320	0426	20. 61F	6.0	11.	9.	.06	.33	2.
25 08 81 0900	0426	18. 61F	3.6	8.	5.	.08	.42	2.
31 08 81 1230	0426	16.8 61F		4.	3.	.05	.27	1.
22 09 81 0930	0426	13. 61F	6.5	10.	7.	.11	.64	2.
14 10 81 0930	0426	6. 61F	6.4	7.	6.	.10	.60	2.
03 11 81 0950	0426	6. 61F	89.	337.	313.	.74	8.9	4.
24 11 81 1000	0426	.0 61F	5.3	11.	9.	.09	.71	2.
16 12 81 1040	0426	.0 61F	2.3	2.0	L1.			
08 01 82 1730	0426	.0 61F	2.2	3.	2.	.04	.25	3.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
08 01 82 1735	0426	.0 61F	1.8	4.	3.	.02	.22	2.
02 02 82 1000	0426	.0 61F	2.3	3.	2.	.05	.36	2.
22 02 82 0930	0426	.0 61F	2.5	5.	4.	.07		2.
16 03 82 1000	0426	5.0 61F	6.5	7.	5.	.08	.61	3.
04 04 82 1415	0426	.0 61F	5.0	10.	9.	.07	.44	4.
26 04 82 0720	0426	.0 61F	36.	148.	134.	.82	7.3	3.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
15 05 79 1230	0426			135.		391.		
15 05 79 1300	0426			135.		411.		
29 05 79 0910	0426	7.9		110.	.0	314.		
29 05 79 0945	0426	7.9		111.	.0	311.		
04 06 79 0815	0426	8.0		121.	.0	353.		
04 06 79 0845	0426	8.0		118.	.0	355.		
12 06 79 0940	0426	8.4		103.		299.		
12 06 79 1015	0426	8.4		104.		299.		
26 06 79 0930	0426	8.6		107.	15.0	299.		
26 06 79 0950	0426	8.6		107.	13.	294.		
04 07 79 0800	0426	8.8		96.	41.	280.		
04 07 79 0820	0426	8.8		97.	34.	278.		
10 07 79 0730	0426	8.5		102.	.0	296.		
10 07 79 0750	0426	8.5		103.		296.		
24 07 79 0830	0426	8.9		90.	3.	282.		
24 07 79 0845	0426	8.9		88.	.0	282.		
30 07 79 1030	0426	9.1		93.	19.	259.		
30 07 79 1045	0426	9.1		88.	63.	275.		
06 08 79 0755	0426	8.9		90.	30.	265.		
06 08 79 0810	0426	8.9		93.	42.	249.		
21 08 79 1025	0426	9.2		98.		289.		
21 08 79 1040	0426	9.1		98.		289.		

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
24 09 79 1015	0426	8.8		86.	5.1	341.		
24 09 79 1020	0426	8.9		86.	4.8	345.		
09 10 79 1015	0426	8.6		129.	2.0	366.		
09 10 79 1020	0426	8.6		129.	.6	366.		
29 10 79 1055	0426	8.3		130.	.0	406.		
29 10 79 1100	0426	8.3		132.	.0	406.		
19 11 79 1025	0426	8.2		134.	.0	414.		
19 11 79 1030	0426	8.2		134.	.0	417.		
10 12 79 1155	0426	8.0		122.	.0	473.		
10 12 79 1200	0426	8.1		120.	.0	470.		
08 01 80 0925	0426	7.7	39. 53L	160.	.0	491.		4.8
08 01 80 0930	0426	7.7	40. 52L	160.	.0	503.		4.9
29 01 80 0825	0426	7.7	36. 53L	148.	.0	504.		4.9
29 01 80 0830	0426	7.7	36. 52L	149.	.0	502.		4.7
19 02 80 0835	0426	7.9	29. 53L	113.	.0	472.		4.7
19 02 80 0840	0426	7.8	29. 52L	113.	.0	469.		4.7
11 03 80 0825	0426	7.6	26. 53L	140.	.0	447.		4.4
11 03 80 0830	0426	7.6	27. 52L	138.	.0	445.		4.2
25 03 80 1410	0426	7.6	22. 53L	110.	.0	419.		3.8
25 03 80 1415	0426	7.7	22. 52L	100.	.0	421.		3.9
09 04 80 0825	0426	7.7	19. 53L	110. 01L	.0	376.	4.7	4.0
09 04 80 0830	0426	7.8	19. 52L	110. 01L	.0	377.	4.7	4.1
22 04 80 0855	0426	8.0	28. 53F	130. 01L	0.	387.	4.3	4.3
22 04 80 0900	0426	7.8	28.	140. 01L	0.	386.	4.4	4.0
05 05 80 1705	0426	8.3	24. 53F	130. 01L	0.	330.	3.4	2.0
05 05 80 1710	0426	8.3	24.	120. 01L	0.	330.	3.4	1.7
21 05 80 1225	0426	8.6	24. 53F	119. 01L	4.2	323.	2.6	.4
21 05 80 1230	0426	8.6	24.	119. 01L	1.0	322.	2.6	.6
03 06 80 1130	0426	8.1	23. 52L	119. 01L	.0	331.	2.2	3.2
17 06 80 0910	0426	8.2	23.	118. 01L	.0	311.	1.8	4.2
02 07 80 0900	0426	8.3	24.	121. 01L	.0	335.	2.4	3.0
14 07 80 1400	0426	9.0	22. 52L	118. 01L	11.2	324.	3.8	.6
15 07 80 0900	0426	9.0	24.	118. 01L		330.	4.1	.5
29 07 80 1100	0426	8.8	24.	116. 01L	7.0	313.	3.4	2.2
12 08 80 0915	0426	9.0	23.	117. 01L	9.8	324.	4.2	1.8
26 08 80 1115	0426	8.9	24.	119. 01L	8.4	337.	4.1	1.0
07 09 80 1305	0426	9.1	22. 52L	118. 01L	12.6	328.	4.3	.8
09 09 80 1000	0426	9.1	21.	116. 01L	10.0	332.	4.7	.8
23 09 80 1000	0426	8.7	30.	130. 01L	2.9	373.	4.9	1.1

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BM2240 LAT. 50D 44M 52S LONG. 112D 31M 27S PR 3 UTM 12 392500E 5622650N
BOW RIVER BELOW BASSANO DAM

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
07 10 80 1000	0426	8.8	28.	127. 01L	5.2	370.	4.7	.8
21 10 80 1100	0426	8.3	31.	130. 01L	.0	375.	4.1	1.6
04 11 80 1048	0426	8.4	34.	134. 01L	.2	390.	4.9	2.3
18 11 80 1310	0426	8.4	32.	139. 01L	.0	398.	5.3	2.5
09 12 80 0900	0426	8.1	39.	175. 01L	.0	516.	7.9	4.2
06 01 81 0900	0426	7.9	28.	145. 01L	.0	429.	5.1	4.4
27 01 81 1000	0426	8.2	36.	134. 01L	.0	390.	5.4	4.1
17 02 81 0900	0426	7.9	34.	132. 01L	.0	401.	6.1	3.7
10 03 81 0800	0426	8.0	38.	127. 01L	.0	394.	6.0	2.8
10 03 81 0830	0426	8.1	38.	127. 01L	.0	391.	6.0	2.8
21 03 81 1213	0426	8.2	42.	133. 01L	.0	409.	5.9	1.8
07 04 81 1100	0426	8.2	32.	133. 01L	.0	403.	4.8	1.9
22 04 81 0800	0426	8.3	31.	134. 01L	.0	406.	4.5	1.3
05 05 81 0800	0426	8.2	36.	142. 01L	.0	440.	6.2	1.2
20 05 81 0900	0426	8.1	32.	138. 01L	.0	391.	2.9	5.5
07 06 81 1300	0426	8.1	28.	122. 01L	.0	305.	1.8	4.9
01 07 81 0820	0426	8.7	29.	130. 01L	2.8	321.	2.1	2.1
06 07 81 1255	0426	8.7	32.	127. 01L	1.4	322.	2.2	1.0
21 07 81 0930	0426	8.2	31.	117. 01L	.0	294.	1.9	2.7
08 08 81 1320	0426	8.4	30.	124. 01L	.2	320.	2.4	3.1
25 08 81 0900	0426	8.6	29.	121. 01L	3.7	313.	2.1	2.2
31 08 81 1230	0426	8.6	30.	122. 01L	.3	324.	3.1	1.2
22 09 81 0930	0426	8.7	29.	127. 01L	8.2	341.	4.7	.6
14 10 81 0930	0426	8.3	29.	138. 01L	.0	382.	5.6	.4
03 11 81 0950	0426	8.1	33.	142. 01L	.0	399.	5.7	.6
24 11 81 1000	0426	8.1	25.	146. 01L	.0	406.	12.	1.0
16 12 81 1040	0426	7.9	42.	171. 01L	.0	462.	8.3	2.8
08 01 82 1730	0426	7.7	42.	183. 01L	.0	490.	7.7	5.0
08 01 82 1735	0426	7.7	41.	183. 01L	.0	496.	8.2	5.0
02 02 82 1000	0426	7.6	35.	155. 01L	.0	421.	7.0	4.6
22 02 82 0930	0426	7.7	39.	150. 01L	.0	420.	9.0	4.5
16 03 82 1000	0426	7.6	33.	140. 01L	.0	417.	13.	4.6
04 04 82 1415	0426	7.7	35.	145. 01L	.0	412.	9.4	4.6
26 04 82 0720	0426	7.8	22.	115. 01L	.0	321.	6.4	3.2

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
24 09 79 1305	0426	.049	.025	.029 13F	.013 46F	.007 66F	.18	L.01 19F	L.1
24 09 79 1310	0426	.050	.023	.020	.010	.007	.21 51F	.01	L.1
09 10 79 1355	0426	.090	.028	.015 13F	.006 46F	.003 66F	.52	.30 19F	L.1
09 10 79 1400	0426	.082	.026	.014	.007	.003	.53 51F	.32	L.1
29 10 79 1355	0426	.060	.047	.057 13F	.040 46F	.028 66F	1.2	.80 19F	L.1
29 10 79 1400	0426	.053	.042	.047	.037	.030	1.2 51F	.82	L.1
19 11 79 1225	0426	.18	.16	.15 13L	.14 46L	.14 66L	1.9 61L	1.5 19L	L.1
19 11 79 1230	0426	.19	.17	.15 03L	.15 56L	.14 56L	1.9 51L	1.5 10L	L.1
10 12 79 1325	0426	.26	.24	.25 13L		.23 66L	2.7 61L	1.6 19L	1.2
10 12 79 1330	0426	.26	.25	.24 03L	.22 56L	.22 56L	2.6 51L	1.4 10L	1.3
08 01 80 1125	0426	.18	.18	.18 13L	.18 46L	.10 66L	2.0 61L	1.4 19L	.5
08 01 80 1130	0426	.18	.18	.18 03L	.17 56L	.16 56L	2.1 51L	1.7 10L	.6
29 01 80 1035	0426	.21	.20	.18 13L	.18 46L	.18 66L	2.1 61L	1.4 19L	.8
29 01 80 1040	0426	.21	.19	.18 03L	.18 56L	.17 56L	2.0 51L	1.4 10L	.8
19 02 80 1035	0426	.21		.20 13L	.19 46L	.18 66L	2.0 61L	1.4 19L	.6
19 02 80 1040	0426	.21	.20	.20 03L	.19 56L	.18 56L	1.9 51L	1.4 10L	.7
11 03 80 1025	0426	.23	.23	.21 13L	.20 46L	.20 66L	1.7 61L	1.1 19L	.6
11 03 80 1030	0426	.23	.22	.21 03L	.20 56L	.19 56L	1.9 51L	1.4 10L	.6
25 03 80 0910	0426	.28	.27	.21 13L	.20 46L	.19 66L	1.8 61L	1.0 19L	.7
25 03 80 0915	0426	.21	.21	.21 03L	.20 56L	.19 56L	1.8 51L	1.0 10L	.6
09 04 80 1020	0426	.26	.22	.13 13L	.13 46L	.11 66L	1.6 61L	.68 19L	.7
09 04 80 1025	0426	.27	.22	.13 03L	.11 56L	.10 56L	1.6 51L	.68 10L	.7
22 04 80 1125	0426	.27	.25	.12 13F	.092 46F	.090 66F	1.1	.60 19F	.5
22 04 80 1130	0426	.27	.24	.11	.11	.086	1.1 51F	.74	.4
06 05 80 1905	0426	.080	.047	.054 13F	.045 46F	.041 66F	.27	.12 19F	L.1
06 05 80 1910	0426	.072	.064	.053	.032	.027	.37 51F	.17	L.1
21 05 80 1555	0426			.040 13F	.021 46F	.015 66F	.22	L.01 19F	L.1
21 05 80 1600	0426	.073		.036	.016	.013	.25 51F	L.01	L.1
03 06 80 1500	0426	.13	.12	.047 03L	.038 56L	.035 56L	.55 61L	.38 10L	.2
17 06 80 1230	0426	.15	.11	.026	.007	.007	.42	.35	L.1
02 07 80 1230	0426	.041	.003	.023	L.003	L.003	.36	.27	L.1
14 07 80 1435	0426	.017	.010	.012 03L	.007 56L	.003 56L	.18 61L	L.01 10L	L.1
15 07 80 1300	0426	.027	.018	.009	.007	.004	.17	L.01	L.1
29 07 80 1310	0426	.035	.027	.015		.004	.23	L.01	L.1
12 08 80 1340	0426	.034	.014	.018	.010	.010	.21	.07	L.1
12 08 80 1345	0426	.032	.016	.015	.009	.005	.20	.07	L.1
26 08 80 1315	0426	.025	.018	.013	.005	L.003	.18	L.01	L.1
07 09 80 1345	0426	.024	.017	.013 03L	.007 56L	.006 56L	.30 61L	L.01 10L	L.1
09 09 80 1230	0426	.019	.010	.014	.003	L.003	.21	L.01	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
23 09 80 1145	0426	.028	.025	.013	.010	.010	.55	.42	L.1
07 10 80 1215	0426	.033	.024	.019	.009	.007	.26	.06	L.1
21 10 80 1330	0426	.38	.17	.12	.10	.090	1.2	1.0	L.1
04 11 80 1330	0426	.16	.15	.11	.088	.086	1.1	.94	L.1
19 11 80 1200	0426	.16	.16	.10	.10	.094	1.1	.94	.1
09 12 80 1100	0426	.18	.17	.15	.15	.15		1.1	.8
06 01 81 1050	0426	.15	.13	.14	.13	.13	1.2	.70	.5
27 01 81 1200	0426	.17	.16	.15	.15	.15	1.1	.68	.6
17 02 81 1100	0426	.20	.19	.16	.16	.14		1.0	1.1
10 03 81 1100	0426	.19	.19	.14	.14	.14	1.3	1.0	.3
21 03 81 1420	0426	.19	.17	.15	.14	.14	1.4	.78	.4
07 04 81 1330	0426	.18	.18	.12	.096	.090	1.0	.72	.3
22 04 81 1000	0426	.17	.15	.14	.11	.11	.87	.52	L.1
22 04 81 1005	0426	.17	.14	.13	.12	.12	.87	.54	L.1
05 05 81 1045	0426	.25	.19	.19	.16	.16	.93	.73	L.1
20 05 81 1130	0426	.15	.11	.039	.034	.029	.76	.46	.1
07 06 81 1115	0426	.11	.094	.026	.021	.015	.37	.27	L.1
01 07 81 1030	0426	.027	.016	.007	L.003	L.003	.22	.12	L.1
06 07 81 1345	0426	.042	.023	.005	.003	L.003	.11	L.01	L.1
21 07 81 1235	0426	.054	.050	.027	.025	.018	.38	.29	L.1
08 08 81 1150	0426	.10	.052	.026	.019	.016	.52	.41	L.1
25 08 81 1345	0426	.042	.042	.029	.026	.026	.36	.27	L.1
31 08 81 1315	0426	.060	.041	.041	.032	.028	.46	.33	L.1
22 09 81 1130	0426		.021	.021	.010	L.003	.23	.02	L.1
14 10 81 1415	0426	.020	.020	.019	.012	.012	.54	.35	L.1
03 11 81 1130	0426	.34	.32	.10	.10	.087	1.5	1.3	.4
24 11 81 1130	0426	.16	.14	.14	.13	.13	1.7	1.5	.3
16 12 81 0930	0426	.20	.20	.20	.19	.19	2.2	1.3	.9
08 01 82 1900	0426	.26	.26	.26	.26	.25	2.3	1.4	.9
02 02 82 1200	0426	.22	.21	.20	.20	.20	2.3	1.5	
22 02 82 1100	0426	.24	.24	.23	.23	.21	2.0	1.4	.8
16 03 82 1130	0426	.25	.23	.22	.21	.21	2.0	1.6	
04 04 82 1300	0426	.30	.28	.27	.26	.26	1.9	1.5	.5
26 04 82 0930	0426	.39	.36	.071	.063	.063	.90	.65	

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
24 09 79 1305	0426	14.	3.9	8.	3.	.19		
24 09 79 1310	0426	14.	3.8	11.	8.			
09 10 79 1355	0426	12.	4.0	11.	7.	.16		
09 10 79 1400	0426	12.	4.2	9.	5.			
29 10 79 1355	0426	7.	5.0	2.	2.	.12		
29 10 79 1400	0426	7.	2.5	2.	L1.			
19 11 79 1225	0426	4.	1.8	8.	5.	.14 02L		
19 11 79 1230	0426	4.	1.8	1.	L1.			
10 12 79 1325	0426	0.	7.5	3.	2.	.06 02L		
10 12 79 1330	0426	0.	2.3	4.	3.			
08 01 80 1125	0426	.5	.7	2.	1.	.04 02L	.24 02L	2. 06L
08 01 80 1130	0426	.5	2.0	L1.	L1.			4. 04L
29 01 80 1035	0426	0.	2.0	3.	3.	.05 02L	.27 02L	1. 06L
29 01 80 1040	0426	0.	2.1	2.	L1.			1. 04L
19 02 80 1035	0426	0.	1.8	9.	7.	.09 02L	.59 02L	1. 06L
19 02 80 1040	0426	0.	2.0	6.	5.			2.
11 03 80 1025	0426	0.	5.5	13.	10.	.12 02L	.89 02L	2. 06L
11 03 80 1030	0426	0.	5.2	15.	12.			1. 04L
25 03 80 0910	0426	0.	17.	3.	3.	.23 02L	1.4 02L	4. 06L
25 03 80 0915	0426	0.	21.0	19.	16.			3. 04L
09 04 80 1020	0426	1. 61F	35.	40.	35.	.27 02L	2.0 02L	5. 06L
09 04 80 1025	0426	1. 61F	40.	38.	32.			6. 04L
22 04 80 1125	0426	10. 61F	1.3	98.	87.	.56	3.0	3. 06F
22 04 80 1130	0426	10. 61F	1.9	96.	86.			4.
06 05 80 1905	0426	11. 61F	3.2	4.	2.	.17	.63	2. 06F
06 05 80 1910	0426	11. 61F	3.0	3.	1.			2.
21 05 80 1555	0426		1.7	4.	3.	.24	.95	2. 06F
21 05 80 1600	0426		2.6	6.	4.			3.
03 06 80 1500	0426	15. 61F	27.0	67.0	60.0	.16 02L	.92 02L	3. 04L
17 06 80 1230	0426	20. 61F	38.	108.	99.	.27	2.4	2.
02 07 80 1230	0426	22. 61F	1.8	1.0	L1.	.07	.30	2.
14 07 80 1435	0426	21.3 61F		L1.	L1.	.06 02L	.29 02L	2. 04L
15 07 80 1300	0426		1.2	L1.	L1.	.05	.16	2.
29 07 80 1310	0426	21.0 61F	2.7	4.	3.	.12	.80	2.
12 08 80 1340	0426	19.0 61F	3.0	5.	5.	.21	.66	2.
12 08 80 1345	0426		3.0	8.	8.			2.
26 08 80 1315	0426	20. 61F	3.5	6.	4.	.05	.27	2.
07 09 80 1345	0426	19.6 61F		7.	5.	.07 02L	.55 02L	2. 04L
09 09 80 1230	0426	19. 61F	2.1	2.	L1.	.03	.65	2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
23 09 80 1145	0426	12.5 61F	2.4	3.	3.	.12	.54	2.
07 10 80 1215	0426	17. 61F	1.7	2.	1.	.08	.53	
21 10 80 1330	0426	7. 61F	16.	35.	27.	.11	.84	2.
04 11 80 1330	0426	0. 61F	9.2	32.	28.	.17	1.3	2.
19 11 80 1200	0426		13.	30.	24.	.20	1.1	1.
09 12 80 1100	0426	0. 61F	2.8	6.	5.	.09	.52	2.
06 01 81 1050	0426	0. 61F	2.9	5.	4.	.02	.10	2.
27 01 81 1200	0426		5.0	10.	7.	.09	.47	1.
17 02 81 1100	0426		10.0	20.	16.	.12	1.1	2.
10 03 81 1100	0426		6.7	17.	15.	.09	.81	1.
21 03 81 1420	0426		6.7	23.	21.	.12	.70	2.
07 04 81 1330	0426	6.0 61F	26.0	74.	69.	.26	2.0	2.
22 04 81 1000	0426	11.0 61F	4.5	14.	12.	.17	.61	2.
22 04 81 1005	0426	11.0 61F	5.3	12.	10.	.15	.57	2.
05 05 81 1045	0426	12.0 61F	2.5	3.	2.	.37	2.1	3.
20 05 81 1130	0426	14.0 61F	55.	136.	122.	.28	2.2	4.
07 06 81 1115	0426	14.0 61F	54.	121.	114.	.19	2.0	3.
01 07 81 1030	0426	16.0 61F	5.8	14.	12.	.08	.42	3.
06 07 81 1345	0426	21.1 61F		9.	8.	.09	.37	2.
21 07 81 1235	0426	18. 61F	19.	31.		.08	.55	2.
08 08 81 1150	0426	21. 61F	9.1	39.	35.	.10	.64	2.
25 08 81 1345	0426	21. 61F	2.8	4.	2.	.10	.56	2.
31 08 81 1315	0426	18.1 61F		4.	2.	L.01	.02	2.
22 09 81 1130	0426	11. 61F	1.7	3.	2.	.08	.43	2.
14 10 81 1415	0426	7. 61F	1.4	1.	L1.	.08	.38	2.
03 11 81 1130	0426	4. 61F	35.	116.	105.	.64	5.6	3.
24 11 81 1130	0426		2.8	2.	2.	.07	.36	2.
16 12 81 0930	0426	.0 61F	1.5	L1.	L1.	.03	.19	3.
08 01 82 1900	0426	.0 61F	1.4	2.	2.	L.01	.19	3.
02 02 82 1200	0426	.0 61F	3.6	4.	4.	.06	.34	2.
22 02 82 1100	0426	.0 61F	3.7	20.	17.	.10		2.
16 03 82 1130	0426	5.0 61F	7.1	10.	8.	.08	.56	3.
04 04 82 1300	0426	6.0 61F	10.	9.	7.	.12	.65	4.
26 04 82 0930	0426	3.0 61F	43.	178.	163.	.75	6.6	3.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOLPHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
24 09 79 1305	0426	8.3		107.	.0	349.		
24 09 79 1310	0426	8.3		107.	.0	351.		
09 10 79 1355	0426	8.2		136.	.0	391.		
09 10 79 1400	0426	8.2		136.	.0	388.		
29 10 79 1355	0426	8.6		126.	1.3	409.		
29 10 79 1400	0426	8.5		125.	1.4	409.		
19 11 79 1225	0426	8.3		133.	.0	417.		
19 11 79 1230	0426	8.3		134.	.0	415.		
10 12 79 1325	0426	8.2		120.	.0	465.		
10 12 79 1330	0426	8.1		114.	.0	464.		
08 01 80 1125	0426	7.7	39. 53L	162.	.0	496.		3.9
08 01 80 1130	0426	7.8	41. 52L	161.	.0	500.		4.0
29 01 80 1035	0426	7.8	35. 53L	145.	.0	534.		3.9
29 01 80 1040	0426	7.7	35. 52L	155.	.0	535.		4.1
19 02 80 1035	0426	7.9	28. 53L	114.	.0	480.		4.2
19 02 80 1040	0426	7.8	30. 52L	117.	.0	478.		4.4
11 03 80 1025	0426	7.7	26. 53L	139.	.0	445.		4.7
11 03 80 1030	0426	7.6	27. 52L	140.	.0	443.		4.3
25 03 80 0910	0426	7.7	23. 53L	120.	.0	445.		4.3
25 03 80 0915	0426	7.7	23. 52L	110.	.0	431.		4.5
09 04 80 1020	0426	7.8	18. 53L	110. 01L	.0	362.	5.2	3.6
09 04 80 1025	0426	7.7	19. 52L	110. 01L	.0	365.	5.1	3.8
22 04 80 1125	0426	7.7	28. 53F	130. 01L	0.	386.	4.7	4.4
22 04 80 1130	0426	7.6	28.	140. 01L	0.	407.	5.2	5.2
06 05 80 1905	0426	8.8	23. 53F	130. 01L	.0	320.	3.6	.4
06 05 80 1910	0426	8.7	24.	130. 01L	.0	325.	3.6	.3
21 05 80 1555	0426	9.1	22. 53F	110. 01L	10.4	320.	4.4	.2
21 05 80 1600	0426	9.1	22.	109. 01L	9.0	320.	4.4	L.1
03 06 80 1500	0426	8.0	23. 52L	115. 01L	.0	319.	2.2	4.9
17 06 80 1230	0426	8.2	22.	118. 01L	.0	311.	1.6	4.4
02 07 80 1230	0426	8.8	23.	118. 01L	4.4	319.	2.7	2.6
14 07 80 1435	0426	9.2	15. 52L	80. 01L	10.3	256.	3.2	.2
15 07 80 1300	0426	9.1	18.		2.5	271.	3.6	.2
29 07 80 1310	0426	8.7	20.	98. 01L	4.3	299.	3.8	.7
12 08 80 1340	0426	9.1	18.	96. 01L	8.3	281.	3.8	.7
12 08 80 1345	0426	9.1	19.	96. 01L	7.3	279.	3.7	.4
26 08 80 1315	0426	9.1	15.	78. 01L	6.0	261.	3.8	.4
07 09 80 1345	0426	9.4	13. 52L	74. 01L	12.3	257.	4.3	.7
09 09 80 1230	0426	9.1	15.	81. 01L	6.2	266.	3.9	.6

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
23	09	80	1145	0426	8.6	29.	127. 01L	1.7	364.	4.8	.5
07	10	80	1215	0426	9.0	24.	112. 01L	6.4	339.	4.9	.4
21	10	80	1330	0426	8.3	30.	132. 01L	.0	395.	4.6	1.5
04	11	80	1330	0426	8.4	36.	135. 01L	.0	400.	5.7	1.1
19	11	80	1200	0426	8.2	32.	138. 01L	.0	401.	5.7	2.3
09	12	80	1100	0426	8.2	39.	174. 01L	.0	507.	7.1	3.5
06	01	81	1050	0426	7.9	28.	145. 01L	.0	424.	5.0	4.4
27	01	81	1200	0426	8.2	36.	134. 01L	.0	393.	4.8	4.2
17	02	81	1100	0426	7.8	33.	130. 01L	.0	398.	5.7	3.6
10	03	81	1100	0426	8.1	38.	127. 01L	.0	399.	6.3	2.6
21	03	81	1420	0426	8.2	41.	133. 01L	.0	400.	5.7	2.0
07	04	81	1330	0426	8.3	32.	132. 01L	.0	403.	5.2	2.1
22	04	81	1000	0426	8.7	31.	134. 01L	2.3	401.	4.5	.7
22	04	81	1005	0426	8.7	31.	133. 01L	3.3	400.	4.5	.6
05	05	81	1045	0426	8.9	35.	141. 01L	11.5	404.	5.6	.1
20	05	81	1130	0426	8.0	33.	135. 01L	.0	402.	3.4	5.4
07	06	81	1115	0426	8.1	29.	121. 01L	.0	308.	1.8	5.0
01	07	81	1030	0426	8.7	29.	128. 01L	2.8	323.	2.3	1.5
06	07	81	1345	0426	8.7	32.	126. 01L	3.9	316.	2.3	.4
21	07	81	1235	0426	8.4	32.	116. 01L	.0	295.	1.7	2.8
08	08	81	1150	0426	8.4	29.	123. 01L	.9	315.	2.3	3.2
25	08	81	1345	0426	8.7	29.	120. 01L	6.5	311.	2.7	1.8
31	08	81	1315	0426	9.0	28.	117. 01L	6.	303.	3.0	.8
22	09	81	1130	0426	9.0	24.	107. 01L	7.3	292.	3.9	L.1
14	10	81	1415	0426	8.4	25.	123. 01L	.2	350.	4.8	L.1
03	11	81	1130	0426	8.2	33.	139. 01L	.0	405.	6.4	.6
24	11	81	1130	0426	8.0	25.	147. 01L	.0	421.	14.	1.0
16	12	81	0930	0426	8.1	40.	175. 01L	.0	469.	8.1	2.4
08	01	82	1900	0426	7.7	43.	189. 01L	.0	512.	8.8	4.8
02	02	82	1200	0426	7.6	35.	160. 01L	.0	427.	7.4	4.6
22	02	82	1100	0426	7.6	37.	140. 01L	.0	396.	7.7	4.4
16	03	82	1130	0426	7.6	31.	135. 01L	.0	402.	14.	4.0
04	04	82	1300	0426	7.6	33.	135. 01L	.0	405.	9.6	4.6
26	04	82	0930	0426	7.8	22.	120. 01L	.0	324.	6.6	3.3

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BN2270 LAT. 50D 2M 39S LONG. 111D 34M 52S PR 3 UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
15 05 79 1600	0426	.034	.022	.019 13F	.016 46F	.013 66F	.29	.02 19F	L.1
15 05 79 1635	0426	.036	.018	.021	.011	.008	.23 51F	.01	L.1
29 05 79 1225	0426	.092	.066	.028 13F	.013 46F	.017 66F	.48	.33 19F	L.1
29 05 79 1226	0426	.081	.073	.028	.015	.016	.50 51F	.35	L.1
12 06 79 1230	0426	.12	.099	.057 13F	.044 46F	.042 66F	.68	.39 19F	L.1
12 06 79 1305	0426	.12	.099	.062	.043	.042	.60 51F	.40	L.1
26 06 79 1130	0426	.077	.071	.035 13F	.030 46F	.026 66F	.37	.19 19F	L.1
26 06 79 1210	0426	.079	.068	.035	.025	.017	.40 51F	.19	L.1
10 07 79 1025	0426		.08	.04 13F	.034 46F	.032 66F	.36	.06 19F	L.1
10 07 79 1040	0426			.039	.032	.027	.25 51F	.03	L.1
24 07 79 1105	0426	.036	.022	.034 13F	.017 46F	.014 66F	.30	.06 19F	L.1
24 07 79 1120	0426	.036	.021	.033	.024	.017			L.1
06 08 79 1050	0426	.038	.024	.027 13F	.011 46F	.005 66F	.31	.03 19F	L.1
06 08 79 1110	0426	.035	.017	.028	.013	.004			L.1
21 08 79 1300	0426	.04	.019	.033 13F	.011 46F	.007 66F	.38	L.01 19F	L.1
21 08 79 1315	0426	.038	.025	.029	.015	.008	.37 51F	L.01	L.1
24 09 79 0925	0426	.026	.010	.021 13F	.010 46F	.003 66F	.24	L.01 19F	L.1
24 09 79 0930	0426	.026	.012	.019	.005	L.003	.25 51F	L.01	L.1
09 10 79 1625	0426	.056	.030	.023 13F	.010 46F	.006 66F	.30	.02 19F	L.1
09 10 79 1630	0426	.053	.029	.016	.009	.006	.32 51F	.03	L.1
30 10 79 1025	0426	.020	.012	.016 13F	.008 46F	.005 66F	.91	.64 19F	L.1
30 10 79 1030	0426	.020	.009	.016	.007	.003	.90 51F	.65	L.1
19 11 79 1425	0426	.13	.12	.092 13L	.083 46L	.077 66L	1.6 61L	1.3 19L	L.1
19 11 79 1430	0426	.13	.12	.085 03L	.079 56L	.071 56L	1.6 51L	1.4 10L	L.1
10 12 79 1455	0426	.18	.16	.16 13L	.15 46L	.15 66L	2.8 61L	1.6 19L	1.0
10 12 79 1500	0426	.20	.16	.17 03L	.14 56L	.14 56L	2.5 51L	1.60 10L	.9
08 01 80 1325	0426	.16	.16	.15 13L	.15 46L	.14 66L	1.9 61L	1.4 19L	.5
08 01 80 1330	0426	.16	.14	.15 03L	.14 56L	.13 56L	2.1 51L	1.4 10L	.5
29 01 80 1240	0426	.19	.18	.17 13L	.16 46L	.16 66L	1.9 61L	1.5 19L	.7
29 01 80 1245	0426	.22	.17	.16 03L	.15 56L	.15 56L	1.7 51L	1.5 10L	.6
19 02 80 1225	0426	.15	.14	.14 13L	.14 46L	.13 66L	1.6 61L	1.4 19L	.3
19 02 80 1230	0426	.19	.17	.19 03L	.13 56L	.13 56L	1.5 51L	1.4 10L	.3
11 03 80 1240	0426	.24	.23	.21 13L	.20 46L	.20 66L	2.0 61L	1.2 19L	.6
11 03 80 1245	0426	.24	.20	.21 03L	.20 56L	.20 56L	2.2 51L	1.4 10L	.6
25 03 80 1045	0426	.28	.25	.20 13L	.18 46L	.18 66L	1.8 61L	1.1 19L	.7
25 03 80 1050	0426	.21	.20	.20 03L	.19 56L	.17 56L	1.7 51L	1.1 10L	.4
09 04 80 1245	0426	.46	.38	.098 13L	.086 46L	.084 66L	1.5 61L	.68 19L	.7
09 04 80 1250	0426	.46	.40	.13 03L	.077 56L	.067 56L	1.5 51L	.74 10L	.6
22 04 80 1555	0426	.37	.32	.12 13F	.10 46F	.083 66F	1.6	1.4 19F	

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BN2270 LAT. 50D 2M 39S LONG. 111D 34M 52S PR 3 UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 04 80 1600	0426	.32	.32	.11	.096	.083	1.6 51F	1.0	.6
06 05 80 1105	0426	.11	.08	.050 13F	.040 46F	.040 66F	.39	.24 19F	L.1
06 05 80 1110	0426	.11	.097	.047		.026	.38 51F	.23	L.1
22 05 80 0825	0426	.062		.038 13F	.020 46F	.013 66F	.28	.01 19F	L.1
22 05 80 0830	0426	.055		.034	.014	.006	.28 51F	L.01	L.1
04 06 80 0830	0426	.15	.15	.038 03L	.031 56L	.030 56L	.61 61L	.39 10L	.1
18 06 80 1045	0426	.17	.14	.031	.027	.021	.42	.38	L.1
03 07 80 0800	0426	.046	L.003	.018	L.003	L.003	.23	.07	L.1
14 07 80 1520	0426	.020	.011	.010 03L	.005 56L	.003 56L	.26 61L	L.01 10L	L.1
16 07 80 0945	0426	.017	.009	.013	.009	.003	.29	L.01	L.1
30 07 80 1015	0426	.026	.018	.020	.006	L.003	.29	L.01	L.1
13 08 80 0900	0426	.030	.008	.011	.005	L.003	.17	L.01	L.1
27 08 80 0915	0426	.023	.016	.010	.003	L.003	.30	L.01	L.1
07 09 80 1430	0426	.012	.008	.008 03L	.006 56L	.003 56L	.36 61L	L.01 10L	L.1
10 09 80 0830	0426	.021	.012	.013	.003	L.003	.26	L.01	L.1
24 09 80 0930	0426	.036	.027	.006	L.003	L.003	.45	.10	L.1
08 10 80 0830	0426	.027	.016	.008	.004	L.003	.27	L.01	L.1
22 10 80 0940	0426	.16	.15	.065	.058	.045	1.2	.98	.1
04 11 80 1630	0426	.15	.12	.091	.067	.067	1.1	.90	L.1
19 11 80 0930	0426	.11	.092	.068	.068	.057	1.1	1.0	.1
09 12 80 1430	0426	.18	.17	.16	.16	.15		1.3	1.4
06 01 81 1400	0426	.15	.15	.13	.12	.12	1.2	.75	.4
06 01 81 1405	0426	.18	.15	.13	.12	.12	1.2	.75	.4
27 01 81 1400	0426	.18	.18	.14	.084		1.2	.87	.6
27 01 81 1405	0426	.18	.17	.15	.13	.10		.90	.6
17 02 81 1500	0426	.21	.18	.16	.15	.13		.90	.7
10 03 81 1400	0426	.16	.16	.12	.12	.12	1.2	1.0	.1
22 03 81 0920	0426	.14	.12	.14	.10	.09	1.3	.86	.3
07 04 81 1530	0426	.15	.15	.11	.099	.095	1.0	.80	.2
22 04 81 1240	0426	.12	.094	.088	.082	.070	.72	.41	L.1
05 05 81 1245	0426	.11	.079	.090	.062	.054	.20	.01	L.1
20 05 81 1330	0426	.14	.13	.048	.043	.037	.70	.42	.2
07 06 81 0915	0426	.12	.11	.025	.018	.013	.40	.28	L.1
01 07 81 1230	0426	.052	.040	.005	.003	L.003	.17	.02	L.1
06 07 81 1440	0426	.021	.009	.004	L.003	L.003	.14	L.01	L.1
21 07 81 1515	0426	.075	.069	.028	.027	.018	.39	.27	L.1
08 08 81 0945	0426	.10	.067	.027	.011	.009	.54	.40	L.1
25 08 81 1130	0426	.029	.026	.015	.011	.011	.17	.02	L.1
31 08 81 1405	0426	.023	.013	.013	.013	.006	.27	.03	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05BN2270 LAT. 50D 2M 39S LONG. 111D 34M 52S PR 3 UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 09 81 1300	0426	.028	.017	.018	.004	L.003	.28	.01	L.1
22 09 81 1305	0426	.028	.017	.012	.005	L.003	.25	L.01	L.1
14 10 81 1200	0426	.040	.027	.010	.009	.005	.29	.04	L.1
03 11 81 1400	0426	.088	.076	.050	.047	.043	1.8	1.5	.5
24 11 81 1400	0426	.20	.18	.17	.14	.14	1.7	1.6	.2
15 12 81 1500	0426	.13	.12	.11	.11	.11	1.7	1.2	.6
09 01 82 0900	0426	.24	.24	.23	.23	.22	2.6	1.6	1.0
02 02 82 1500	0426	.21	.19	.19	.18	.18	1.9	1.5	
22 02 82 1300	0426	.22	.21	.21	.19	.19	1.9	1.6	
16 03 82 1300	0426	.25	.24	.22	.21	.21	1.8	1.6	
04 04 82 1100	0426	.26	.26	.25	.24	.23	1.8	1.5	.3
26 04 82 1040	0426	.32	.30	.062	.056	.056	1.0	.85	

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
15 05 79 1600	0426	17.	6.1	4.	1.	.06		
15 05 79 1635	0426	17.	7.5	6.	1.	.08		
29 05 79 1225	0426	16.	25.	27.	23.	.22		
29 05 79 1226	0426	16.	21.	17.	14.	.19		
12 06 79 1230	0426	21.	21.	24.	19.			
12 06 79 1305	0426	21.	25.	26.	20.	.16		
26 06 79 1130	0426	21.5	13.	17.	10.	.18		
26 06 79 1210	0426	21.5	12.	20.	12.	.19		
10 07 79 1025	0426	22.5	3.4	4.	2.	.07		
10 07 79 1040	0426	22.5	3.8	2.	L1.			
24 07 79 1105	0426	17.5		L1.	L1.	.04		
24 07 79 1120	0426	17.5		L1.	L1.			
06 08 79 1050	0426	22.5	1.6	3.4	L1.	L.01		
06 08 79 1110	0426	22.5	1.6	L1.	2.			
21 08 79 1300	0426	23.5	1.5	L1.	L1.	.06		
21 08 79 1315	0426	23.5	1.1	3.4	2.8			

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BN2270 LAT. 50D 2M 39S LONG. 111D 34M 52S PR 3 UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
24 09 79 0925	0426	13.	2.4	4.	2.	.04		
24 09 79 0930	0426	13.	2.6	5.	4.			
09 10 79 1625	0426	12.	6.1	13.	9.	.28		
09 10 79 1630	0426	12.	5.9	14.	11.			
30 10 79 1025	0426	4.	3.0	10.	8.	.07		
30 10 79 1030	0426	4.	3.3	L1.	L1.			
19 11 79 1425	0426	1.	2.5	22.	18.	.08 02L		
19 11 79 1430	0426	1.	30.	3.	L1.			
10 12 79 1455	0426	0.	8.0	4.	2.	.08 02L		
10 12 79 1500	0426	0.	2.0	6.	4.			
08 01 80 1325	0426	1.	4.0	L1.	L1.	.06 02L	.28 02L	3. 06L
08 01 80 1330	0426	1.	3.2	2.	L1.			3. 04L
29 01 80 1240	0426	0.	4.1	6.	5.	.04 02L	.24 02L	1. 06L
29 01 80 1245	0426	0.	4.5	2.	2.			1. 04L
19 02 80 1225	0426	0.	2.4	12.	9.	.18 02L	.97 02L	1, 06L
19 02 80 1230	0426	0.	2.5	11.	9.			1.
11 03 80 1240	0426	0.	4.1	14.	11.	.07 02L	.41 02L	1. 06L
11 03 80 1245	0426	0.	7.5	14.	11.			2. 04L
25 03 80 1045	0426	.5	31.	12.	10.	.26 02L	1.9 02L	3. 06L
25 03 80 1050	0426	.5	30.0	22.	18.			2. 04L
09 04 80 1245	0426	2. 61F	48.	159.	148.	2.6 02L	6.1 02L	4. 06L
09 04 80 1250	0426	2. 61F	54.	149.	137.			5. 04L
22 04 80 1555	0426	11. 61F	1.5	167.	151.	1.2	8.2	3. 06F
22 04 80 1600	0426	11. 61F	1.9	165.	151.			5.
06 05 80 1105	0426	16. 61F	18.0	38.	32.	.23	1.3	2. 06F
06 05 80 1110	0426	16. 61F	18.0	41.	36.			2.
22 05 80 0825	0426		6.0	11.	11.	.09	.48	3. 06F
22 05 80 0830	0426		4.5	13.	12.			3.
04 06 80 0830	0426	14. 61F	34.	94.0	85.0	.10 02L	.49 02L	3. 04L
18 06 80 1045	0426	20. 61F	40.	109.	101.	.23	2.0	3.
03 07 80 0800	0426	20. 61F	9.5	19.0	18.0	.14	.73	2.
14 07 80 1520	0426	22.0 61F		2.	2.	.07 02L	.24 02L	3. 04L
16 07 80 0945	0426		1.8	1.	L1.	.05	.21	4.
30 07 80 1015	0426	18.0 61F	7.4	7.	5.	.06	.35	3.
13 08 80 0900	0426	20.0 61F	7.0	18.	17.	.11	.75	3.
27 08 80 0915	0426	15. 61F	5.7	7.	5.	.10	.70	2.
07 09 80 1430	0426	21.2 61F		4.	2.	.08 02L	.36 02L	3. 04L
10 09 80 0830	0426	16. 61F	4.5	4.	2.	.06	.37	2.
24 09 80 0930	0426	12. 61F	11.	25.	21.	.17	1.0	3.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05BN2270   LAT. 50D 2M 39S   LONG. 111D 34M 52S   PR 3   UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
08 10 80 0830	0426	15. 61F	4.6	7.	6.	.14	.46	
22 10 80 0940	0426	6. 61F	28.	65.	59.	.39	2.7	2.
04 11 80 1630	0426	0. 61F	9.5	29.	22.	.16	1.1	2.
19 11 80 0930	0426		8.	11.	8.	.12	.61	1.
09 12 80 1430	0426	0. 61F	2.5	3.	2.	.04	.10	3.
06 01 81 1400	0426	0. 61F	6.6	13.	11.	.06	.51	2.
06 01 81 1405	0426	0. 61F	6.0	11.	9.	.06	.46	2.
27 01 81 1400	0426		7.7	16.	11.	.13	.83	2.
27 01 81 1405	0426		8.2	16.	12.	.10	.51	2.
17 02 81 1500	0426		10.0	20.	17.	.11	.81	3.
10 03 81 1400	0426		9.5	33.	30.	.12	1.0	1.
22 03 81 0920	0426		6.9	9.	8.	.09	.57	2.
07 04 81 1530	0426	7.0 61F	18.0	28.	24.	.28	1.4	2.
22 04 81 1240	0426	12.0 61F	3.8	5.	4.	.13	.42	2.
05 05 81 1245	0426	13.0 61F	2.3	3.	2.	.10	1.2	3.
20 05 81 1330	0426	16.0 61F	40.	77.	69.	.29	1.9	4.
07 06 81 0915	0426	14.0 61F	67.	160.	155.	.24	2.5	3.
01 07 81 1230	0426	18.0 61F	24.	54.	51.	.18	1.0	3.
06 07 81 1440	0426	22.0 61F		28.	24.	.11	.59	3.
21 07 81 1515	0426	20. 61F	23.	48.		.15	1.0	2.
08 08 81 0945	0426	21. 61F	8.5	35.	30.	.13	.90	3.
25 08 81 1130	0426	21. 61F	4.3	11.	7.	.11	.57	2.
31 08 81 1405	0426	18.1 61F		6.	2.	.07	.50	3.
22 09 81 1300	0426	13. 61F	3.5	8.	5.	.08	.50	3.
22 09 81 1305	0426	13. 61F	3.5	6.	4.	.08	.47	3.
14 10 81 1200	0426	5. 61F	5.1	6.	4.	.26	1.3	4.
03 11 81 1400	0426		7.5	8.	6.	.33	.94	4.
24 11 81 1400	0426		4.2	6.	5.	.08	.48	2.
15 12 81 1500	0426	.0 61F	1.5	1.0	L1.	.03	.18	2.
09 01 82 0900	0426	.0 61F	1.7	4.	3.	.06	.33	3.
02 02 82 1500	0426	.0 61F	2.9	4.	4.	L.01	.24	2.
22 02 82 1300	0426	.0 61F	3.7	12.	10.	.13		3.
16 03 82 1300	0426	5.0 61F	8.4	15.	12.	.12	.77	4.
04 04 82 1100	0426	5.0 61F	14.	15.	13.	.16	.89	5.
26 04 82 1040	0426	5.0 61F	45.	153.	139.	.58	5.4	3.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BN2270   LAT. 50D 2M 39S LONG. 111D 34M 52S   PR 3   UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
15 05 79 1600	0426			99.		349.		
15 05 79 1635	0426			99.		349.		
29 05 79 1225	0426	7.9		115.	.0	337.		
29 05 79 1226	0426	7.9		116.	.0	337.		
12 06 79 1230	0426	8.3		110.	.0	317.		
12 06 79 1305	0426	8.3		110.	.0	332.		
26 06 79 1130	0426	8.6		107.	18.	330.		
26 06 79 1210	0426	8.5		108.	15.	315.		
10 07 79 1025	0426	9.3		75.	42.	290.		
10 07 79 1040	0426	9.2		76.	53.	296.		
24 07 79 1105	0426	9.0		72.	.0	320.		
24 07 79 1120	0426	9.0		70.	.0	321.		
06 08 79 1050	0426	9.1		80.	53.	366.		
06 08 79 1110	0426	9.2		85.	48.	353.		
21 08 79 1300	0426	9.2		84.		311.		
21 08 79 1315	0426	9.4		84.		309.		
24 09 79 0925	0426	8.3		114.	.0	388.		
24 09 79 0930	0426	8.2		114.	.0	389.		
09 10 79 1625	0426	8.2		136.	.0	436.		
09 10 79 1630	0426	8.6		135.	2.9	432.		
30 10 79 1025	0426	8.3		132.	.0	451.		
30 10 79 1030	0426	8.4		131.	.0	449.		
19 11 79 1425	0426	8.3		133.	.0	420.		
19 11 79 1430	0426	8.3		133.	.0	420.		
10 12 79 1455	0426	8.1		122.	.0	501.		
10 12 79 1500	0426	8.1		118.	.0	499.		
08 01 80 1325	0426	7.8	40. 53L	164.	.0	516.		3.1
08 01 80 1330	0426	7.8	40. 52L	166.	.0	518.		3.2
29 01 80 1240	0426	7.8	36. 53L	153.	.0	481.		3.0
29 01 80 1245	0426	7.8	35. 52L	155.	.0	487.		3.2
19 02 80 1225	0426	7.9	29. 53L	112.	.0	486.		3.5
19 02 80 1230	0426	7.8	29. 52L	116.	.0	487.		4.0
11 03 80 1240	0426	7.7	27. 53L	148.	.0	466.		4.5
11 03 80 1245	0426	7.6	28. 52L	136.	.0	466.		4.4
25 03 80 1045	0426	7.7	22. 53L	120.	.0	446.		4.0
25 03 80 1050	0426	7.6	23. 52L	110.	.0	435.		4.0
09 04 80 1245	0426	7.7	19. 53L	110. 01L	.0	386.	5.9	3.6
09 04 80 1250	0426	7.8	20. 52L	110. 01L	.0	384.	6.0	3.9
22 04 80 1555	0426	7.6	28. 53F	130. 01L	0.	385.	4.7	4.4

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        PAGE 100                                        NAQUADAT DETAILED REPORT
                                                    PH DIC ALK COND CL SIO2

     STATION 00AT05BN2270    LAT. 50D  2M 39S  LONG. 111D 34M 52S   PR 3   UTM 12 458400E 5543500N
     BOW RIVER AT RONALANE BRIDGE

                                  10301L     06152F      10106L      10151L      02041L      17206L      14105L
                                    PH       CARBON    ALKALINITY  ALKALINITY   SPECIFIC    CHLORIDE     SILICA
                                            DISSOLVED    TOTAL       PHENOL     CONDUCT.   DISSOLVED   REACTIVE
       SAMPLE DATE                          INORGANIC    CACO3     PHTHALEIN
          MST         SUBM                     C                     CACO3                    CL         SIO2
      D  M  Y  HR      ID      PH UNITS      MG/L        MG/L        MG/L        US/CM       MG/L        MG/L

     22 04 80 1600   0426        7.6        30.         130. 01L     0.          407.        5.2         5.2
     06 05 80 1105   0426        8.7        23. 53F     130. 01L      .0         339.        3.6          .6
     06 05 80 1110   0426        8.7        24.         130. 01L     3.3         340.        3.5          .8
     22 05 80 0825   0426        8.8        22. 53F     107. 01L     4.5         375.        4.0          .8
     22 05 80 0830   0426        8.7        23.         107. 01L      .7         374.        4.0          .8

     04 06 80 0830   0426        8.1        23. 52L     117. 01L      .0         342.        2.4         4.8
     18 06 80 1045   0426        8.2        23.         119. 01L      .0         324.        1.8         4.4
     03 07 80 0800   0426        8.7        23.         120. 01L     5.0         351.        2.6         2.8
     14 07 80 1520   0426        9.0        21. 52L     103. 01L     8.3         364.        3.8         1.0
     16 07 80 0945   0426        8.4        23.         109. 01L      .0         392.        4.0          .6

     30 07 80 1015   0426        8.7        22.         110. 01L     5.4         369.        4.0          .6
     13 08 80 0900   0426        8.7        21.         101. 01L     2.0         335.        3.7         1.0
     27 08 80 0915   0426        8.8        20.          93. 01L      .2         316.        4.0          .6
     07 09 80 1430   0426        9.0        18. 52L     116. 01L     9.5         351.        4.7          .4
     10 09 80 0830   0426        8.9        17.          89. 01L     1.9         331.        4.9          .9

     24 09 80 0930   0426        8.4        29.         125. 01L      .0         398.        5.0          .6
     08 10 80 0830   0426        8.5        25.         110. 01L      .0         369.        5.0          .6
     22 10 80 0940   0426        8.2        32.         135. 01L      .0         418.        4.8         2.2
     04 11 80 1630   0426        8.5        36.         138. 01L     2.          412.        6.7         1.2
     19 11 80 0930   0426        8.2                    143. 01L      .0         418.        5.8         1.8

     09 12 80 1430   0426        8.0        39.         178. 01L      .0         512.        8.7         2.9
     06 01 81 1400   0426        8.0        28.         145. 01L      .0         435.        5.9         4.6
     06 01 81 1405   0426        8.0        28.         145. 01L      .0         434.        5.9         4.5
     27 01 81 1400   0426        8.1        36.         135. 01L      .0         404.        5.8         3.8
     27 01 81 1405   0426        8.1        36.         137. 01L      .0         410.        5.9         3.7

     17 02 81 1500   0426        7.8        32.         129. 01L      .0         405.        5.3         3.8
     10 03 81 1400   0426        8.3        37.         129. 01L      .0         390.        6.1         2.5
     22 03 81 0920   0426        8.3        41.         131. 01L      .0         411.        5.2         1.3
     07 04 81 1530   0426        8.3        33.         134. 01L      .0         417.        5.1         1.8
     22 04 81 1240   0426        8.9        29.         136. 01L      .9         413.        5.7          .2

     05 05 81 1245   0426        9.4        26.         115. 01L    23.0         355.        5.4          .2
     20 05 81 1330   0426        8.0        31.         129. 01L      .0         399.        3.8         4.7
     07 06 81 0915   0426        8.1        29.         123. 01L      .0         315.        1.8         5.1
     01 07 81 1230   0426        8.8        28.         124. 01L     2.3         330.        2.9         1.6
     06 07 81 1440   0426        8.8        30.         117. 01L     2.1         314.        2.6          .7

     21 07 81 1515   0426        8.4        32.         120. 01L      .0         319.        2.1         2.9
     08 08 81 0945   0426        8.5        29.         122. 01L      .9         317.        2.3         3.2
     25 08 81 1130   0426        8.9        26.         115. 01L     6.0         311.        3.0          .6
     31 08 81 1405   0426        9.0        26.         109. 01L     3.1         336.        3.9         1.0
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NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05BN2270 LAT. 50D 2M 39S LONG. 111D 34M 52S PR 3 UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
22 09 81 1300	0426	8.9	24.	105. 01L	4.0	338.	4.5	.8
22 09 81 1305	0426	8.9	24.	105. 01L	7.4	338.	4.5	.4
14 10 81 1200	0426	8.3	27.	131. 01L	.0	425.	5.5	.6
03 11 81 1400	0426	8.3	33.	140. 01L	.0	430.	8.2	.1
24 11 81 1400	0426	8.1	25.	146. 01L	.0	428.	14.	1.2
15 12 81 1500	0426	8.1	39.	168. 01L	.0	457.	7.3	2.1
09 01 82 0900	0426	7.7	45.	203. 01L	.0	542.	8.6	4.4
02 02 82 1500	0426	7.6	35.	160. 01L	.0	432.	6.7	4.8
22 02 82 1300	0426	7.6	37.	140. 01L	.0	411.	6.3	4.4
16 03 82 1300	0426	7.6	31.	135. 01L	.0	399.	8.0	4.0
04 04 82 1100	0426	7.6	32.	130. 01L	.0	414.	10.	4.7
26 04 82 1040	0426	7.8	23.	115. 01L	.0	337.	6.5	3.2

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
23 05 79 0830	0426	.21	.112	.007 13F	L.003 46F	L.003 66F	.25	.08 19F	L.1
23 05 79 0900	0426	.19	.12	.008	L.003	L.003	.18 51F	.05	L.1
05 06 79 1335	0426	.225	.070	.008 13F	L.003 46F	.005 66F	.16	.07 19F	L.1
05 06 79 1400	0426	.20	.19	.006	L.003	L.003	.16 51F	.08	L.1
19 06 79 1120	0426	.020	.020		.011 46F	L.003 66F	.15	.05 19F	L.1
19 06 79 1140	0426	.020	.020		.005	L.003	.15 51F	.05	L.1
05 07 79 1305	0426	.022	.019	L.003 13F	L.003 46F	L.003 66F	.19	.08 19F	L.1
05 07 79 1315	0426	.03	.011	L.003	L.003	L.003	.24 51F	.08	L.1
18 07 79 1105	0426	.018	.005	.008 13F	L.003 46F	L.003 66F	.13	.02 19F	L.1
18 07 79 1120	0426	.020	.008	L.003	L.003	L.003	.13 51F	.01	L.1
31 07 79 1545	0426	.015	.012	.005 13F	.004 46F		.12	L.01 19F	L.1
31 07 79 1600	0426	.017	.011	.008	.003 56L	L.003	.16 51F	.01	L.1
18 09 79 1340	0426	.016	.009	.004 13F	L.003 46F	L.003 66F	.15	L.01 19F	L.1
18 09 79 1345	0426	.015	.012	.003	L.003	L.003		.01	L.1
02 10 79 1255	0426	.012	.006	.012 13F	L.003 46F	L.003 66F	.11	L.01 19F	L.1
02 10 79 1300	0426	.009	.007	.005	L.003	L.003	.11 51F	L.01	L.1
18 10 79 0925	0426	.017	.009	.006 13F	.004 46F	L.003 66F	.16	L.01 19F	L.1
18 10 79 0930	0426	.022	.012	L.003	L.003	L.003	.12 51F	.01	L.1
06 11 79 1325	0426	.007	.003	.003 13L	L.003 46L	L.003 66L	.11 61L	.04 19L	L.1
06 11 79 1330	0426	.006	.006	.004 03L	L.003 56L	L.003 56L	.14 51L	.04 10L	L.1
27 11 79 0855	0426	.003	.003	L.003 13L	L.003 46L	L.003 66L	.25 61L	.08 19L	L.1
27 11 79 0900	0426	.004	.004	.004 03L	.003 56L	.003 56L	.30 51L	.09 10L	L.1
18 12 79 0925	0426	.004	.003	.004 13L	L.003 46L	L.003 66L	.41 61L	.21 19L	L.1
18 12 79 0930	0426	.007	.006	.007 03L	.004 56L	L.003 56L	.39 51L	.21 10L	L.1
15 01 80 1055	0426	.009	.003	L.003 13L	L.003 46L	L.003 66L	.35 61L	.28 19L	L.1
15 01 80 1100	0426	.015	.009	.011 03L	.003 56L	L.003 56L	.35 51L	.28 10L	L.1
05 02 80 0940	0426	.006	.003	.003 13L	.003 46L				L.1
05 02 80 0945	0426	.007	.007	.007 03L	.007 56L	.003 56L	.45 51L	.29 10L	L.1
26 02 80 0910	0426	.011	L.003	.003 13L	L.003 46L	L.003 66L	.37 61L	.32 19L	L.1
26 02 80 0915	0426	.008	.005	L.003 03L	L.003 56L	L.003 56L	.38 51L	.32 10L	L.1
18 03 80 1325	0426	.026	.015	.012 13L	.009 46L	L.003 66L	.44 61L	.17 19L	L.1
18 03 80 1330	0426	.034	.022	.017 03L	.006 56L	.003 56L	.45 51L	.17 10L	L.1
01 04 80 0905	0426	.019	.013	.006 13L	.004 46L	L.003 66L	.18 61L	.01 19L	L.1
01 04 80 0910	0426	.023	.015	.006 03L	.005 56L	L.003 56L	.21 51L	.01 10L	L.1
15 04 80 0955	0426	.032	.014	.011 13L	L.003 46L	L.003 66L	.32 61L	L.01 19L	L.1
15 04 80 1000	0426	.026	.015	.011 03L	.011 56L	.004 56L	.24 51L	.01 10L	.1
29 04 80 1425	0426	.17	.16	.008 13F	.006 46F	L.003 66F	.30	.06 19F	L.1
29 04 80 1430	0426	.18	.16	.007	L.003	L.003	.33 51F	.12	L.1
13 05 80 1320	0426		.032	.005 13L	.004 46L	L.003 66L	.13 61L	.02 19L	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
13 05 80 1325	0426	.031	.028	.005 03L	.003 56L	L.003 56L	.09 51L	.01 10L	L.1
27 05 80 1355	0426	2.0	1.8	.006 13L		L.003 66L	.35 61L	.18 19L	.1
27 05 80 1400	0426	2.0		.004 03L	.003	L.003 56L	.32 51L	.17 10L	.1
10 06 80 1330	0426	.064	.052	.003 03L	.003 56L	L.003 56L	.21 61L	.04 10L	L.1
24 06 80 1320	0426	.060	L.003	.003	.003	L.003	.12	.05	L.1
08 07 80 1455	0426	.009	.007	L.003	L.003	L.003	.10	.01	L.1
08 07 80 1500	0426	.007	.005	L.003	L.003	L.003	.11	L.01	L.1
22 07 80 1330	0426	.11	.008	.003	L.003	.003	.23	L.01	L.1
06 08 80 1330	0426	.014	.009	.004	.004	L.003	.12	L.01	L.1
19 08 80 1210	0426	.018	.009	.011	.005	L.003	.14	L.01	L.1
03 09 80 1215	0426	.006	.005	L.003		L.003	.06	L.01	L.1
16 09 80 1200	0426	.008	.003	L.003	L.003	L.003	.15	.03	L.1
30 09 80 1600	0426	.021	.011	.006	L.003	L.003	.16		L.1
15 10 80 1215	0426	.007	.005	L.003	L.003	L.003	.11	L.01	L.1
30 10 80 1220	0426	.027	.010	.003	L.003	L.003	.10	.02	L.1
11 11 80 1600	0426	.010	.005	.006	.005	L.003	.13	.04	L.1
25 11 80 1320	0426	.011	.005	.004	.004	L.003	.14	.11	L.1
16 12 80 1530	0426	1.1	.82	.009	.009	L.003	.29	.11	L.1
13 01 81 1310	0426	.025		.006	.006	L.003	.32	.11	L.1
03 02 81 1400	0426	.053	.012	L.003	L.003	L.003	.26	.11	L.1
22 02 81 1700	0426	.12	.11	.015	.003	L.003		.14	L.1
15 03 81 1330	0426	.007	.004	L.003	L.003	L.003	.13	L.01	L.1
02 04 81 1400	0426	.021	.004	L.003	L.003	L.003	.16	.02	L.1
14 04 81 1430	0426	.011	.006	.004	L.003	L.003	.16	.01	L.1
28 04 81 1330	0426	.069	.069	.005	.005	L.003	.14	.04	L.1
28 04 81 1335	0426	.055	.049	.005	.003	L.003	.14	.05	L.1
12 05 81 1315	0426	.095	.076	.004	L.003	L.003	.17	.08	L.1
26 05 81 1630	0426	.38	.33	.011	.003	L.003	.23	.08	L.1
16 06 81 1315	0426	.26	.20	.019	.013	.005	.57	.32	L.1
13 07 81 1345	0426	.020	.009	.003	L.003	L.003	.12	.02	L.1
28 07 81 1530	0426	.024	.013	.003	.003	L.003	.20	.02	L.1
18 08 81 1410	0426	.014	.014	.004	L.003	L.003	.12	L.01	L.1
09 09 81 1200	0426	.007	.007	L.003	L.003	L.003	.10	L.01	L.1
29 09 81 1400	0426	.008	.003	L.003	L.003	L.003	.13	L.01	L.1
20 10 81 1515	0426	.007	.003	.005	L.003	L.003	.12	.02	L.1
11 11 81 0900	0426	.024	.013	.007	.003	L.003	.14	.02	L.1
30 11 81 0830	0426	.007	L.003	.005	L.003	L.003	.35	.20	L.1
14 12 81 1300	0426	.015	.008	.005	.005	.005	.28	.18	L.1
09 01 82 1600	0426	.016	.007	.008	.007	.007	3.3	3.0	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
10 02 82 1130	0426	.021	.017	.017	.009	.009	.48	.29	L.1
23 02 82 1430	0426	.006	L.003	L.003	L.003	L.003	.40	.31	L.1
23 03 82 0930	0426	.021	.011	.009	.005	L.003	.32	.20	L.1
03 04 82 1030	0426	.025	.017	.011	.003	L.003	.36	.12	L.1
27 04 82 1400	0426	.031	.029	.010	.003	L.003	.20	.01	L.1

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
23 05 79 0830	0426	13.	115.	264.		.50		
23 05 79 0900	0426	13.	110.	288.	260.	.48		
05 06 79 1335	0426	15.	83.	170.	152.	.75		
05 06 79 1400	0426	15.	82.	233.	212.	.84		
19 06 79 1120	0426	15.5	18.	24.	22.	.04		
19 06 79 1140	0426	15.5	18.	24.	24.	.02		
05 07 79 1305	0426	23.5		60.	50.	.09		
05 07 79 1315	0426	23.5		31.	23.			
18 07 79 1105	0426	23.5	4.5	3.	2.	.04		
18 07 79 1120	0426	23.5	5.6	4.	3.			
31 07 79 1545	0426	23.	2.3	1.6	1.2	.06		
31 07 79 1600	0426	23.	1.8	6.4	4.8			
18 09 79 1340	0426	16.	4.1	L1.	L1.	.8		
18 09 79 1345	0426		6.2	8.	L1.			
02 10 79 1255	0426	12.	4.1	6.	4.	.08		
02 10 79 1300	0426	12.	4.2	9.	8.			
18 10 79 0925	0426	8.	5.5	8.	6.	.04		
18 10 79 0930	0426	8.	8.4	36.	28.			
06 11 79 1325	0426	4.	3.2	6.	5.	.04 02L		
06 11 79 1330	0426	4.	2.3	7.	6.			
27 11 79 0855	0426	0.	2.1	L1.	L1.	.07 02L		
27 11 79 0900	0426	0.	2.8	L1.	L1.			
18 12 79 0925	0426	1.	1.6	2.	1.	.04 02L		
18 12 79 0930	0426	1.	1.8	3.	2.			

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
15 01 80 1055	0426	0.	1.7	2.	2.	.04 02L	.22 02L	2. 06L
15 01 80 1100	0426	0.	2.0	3.	2.			2. 04L
05 02 80 0940	0426	0.	2.1	2.	L1.	.02 02L	.07 02L	
05 02 80 0945	0426	0.	2.8	L1.	L1.			2. 04L
26 02 80 0910	0426	.5	3.2	5.	4.	.03 02L	.19 02L	4. 06L
26 02 80 0915	0426	.5	3.2	7.	6.			2. 04L
18 03 80 1325	0426	0.	16.	13.	11.	.09 02L	.42 02L	4. 06L
18 03 80 1330	0426	0.	17.	4.	3.			4. 04L
01 04 80 0905	0426	1. 61F	15.0	12.	12.	.09 02L	.37 02L	4. 06L
01 04 80 0910	0426	1. 61F	8.0	6.	6.			4. 04L
15 04 80 0955	0426	10. 61F	1.7	3.	2.	.13 02L	.50 02L	3. 06L
15 04 80 1000	0426	10. 61F	1.7	6.	5.			4. 04L
29 04 80 1425	0426		28.0	234.	215.	.41	4.0	3. 06F
29 04 80 1430	0426		47.0	231.	213.			4.
13 05 80 1320	0426		13.0	27.		.10 02L	.50 02L	2. 06L
13 05 80 1325	0426		13.0	32.	29.			2. 04L
27 05 80 1355	0426	11. 61F	1250.	3425.	3272.	1.3 02L	12.2 02L	2. 06L
27 05 80 1400	0426	11. 61F	1250.	3135.	2985.			2. 04L
10 06 80 1330	0426	19. 61F	38.0	88.0	73.0	.14 02L	.56 02L	2. 04L
24 06 80 1320	0426	18. 61F	28.	82.0	72.0	.11	1.1	2.
08 07 80 1455	0426		4.0	5.0	4.0	.05	.26	2.
08 07 80 1500	0426		4.0	6.0	5.0	.06	.25	2.
22 07 80 1330	0426		4.2	6.	5.	.10	.32	2.
06 08 80 1330	0426	17.0 61F	6.5	9.	7.	.06	.06	2.
19 08 80 1210	0426	20.0 61F	3.2	7.	6.	.06	.29	2.
03 09 80 1215	0426	15. 61F	3.4	6.	4.	.01	.20	2.
16 09 80 1200	0426	13. 61F	5.0	9.	8.	.04	.26	2.
30 09 80 1600	0426	15. 61F	9.7	17.	9.	.06	.42	2.
15 10 80 1215	0426	9. 61F	3.8	5.	3.	.08	.22	2.
30 10 80 1220	0426	6. 61F	15.	26.	24.	.10	.55	1.
11 11 80 1600	0426		6.0	11.	9.	.04	.31	2.
25 11 80 1320	0426		6.6	11.	10.	.06	.31	2.
16 12 80 1530	0426		220.	1980.	1870.	1.1	13.	2.
13 01 81 1310	0426	0. 61F	14.	31.	29.	.03	.47	2.
03 02 81 1400	0426		6.9	27.	25.			2.
22 02 81 1700	0426		62.0	186.	176.	.54	3.6	3.
15 03 81 1330	0426		2.6	5.	3.	.05	.14	2.
02 04 81 1400	0426	7.0 61F	5.0	6.	5.	.10	.41	3.
14 04 81 1430	0426	7.0 61F	2.1	3.	2.0	.06	.17	2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
28 04 81 1330	0426	10.0 61F	58.	118.	108.	.29	1.7	3.
28 04 81 1335	0426	10.0 61F	55.	112.	104.	.23	.87	3.
12 05 81 1315	0426	11.0 61F	66.	195.	179.	.27	2.3	3.
26 05 81 1630	0426	13.0 61F	270.	940.	922.	.58	6.4	4.
16 06 81 1315	0426	13.0 61F	200.	452.	419.	.51	4.8	6.
13 07 81 1345	0426	21.0 61F	19.	26.	23.	.08	.41	2.
28 07 81 1530	0426	21.0 61F	20.	23.	19.	.08	.49	3.
18 08 81 1410	0426	23. 61F	2.6	4.	2.	.05	.18	2.
09 09 81 1200	0426	19. 61F	2.2	6.	5.	.04	.21	2.
29 09 81 1400	0426	11. 61F	2.8	2.	1.	.04	.16	3.
20 10 81 1515	0426	7.0 61F	3.9	7.	5.	.06	.23	2.
11 11 81 0900	0426		5.7	9.	7.	.06	.38	2.
30 11 81 0830	0426	.0 61F	2.9	6.	5.	.03	.18	3.
14 12 81 1300	0426	.0 61F	2.0	8.0	5.0	.03	.16	2.
09 01 82 1600	0426	.0 61F	.6	10.	8.	L.01	.23	4.
10 02 82 1130	0426	.0 61F	2.4	5.	2.	.04	.23	2.
23 02 82 1430	0426	.0 61F	3.7	4.	3.	.05		3.
23 03 82 0930	0426	5. 61F	5.6	6.	5.	.08	.47	3.
03 04 82 1030	0426	4.0 61F	8.5	15.	13.	.10	.68	6.
27 04 82 1400	0426	11.0 61F	27.	32.	28.	.17	.98	4.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
23 05 79 0830	0426	8.2		107.	.0	290.		
23 05 79 0900	0426	8.2		107.	.0	279.		
05 06 79 1335	0426	8.1		96.	.0	255.		
05 06 79 1400	0426	7.9		95.	.0	257.		
19 06 79 1120	0426	8.2		112.	.0	276.		
19 06 79 1140	0426	8.2		114.	.0	273.		
05 07 79 1305	0426	7.9		138.	.0	446.		
05 07 79 1315	0426	8.1		133.	.0	410.		
18 07 79 1105	0426	8.3		124.	.0	371.		

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
18 07 79 1120	0426	8.4		128.		373.		
31 07 79 1545	0426	8.6		116.	.0	354.		
31 07 79 1600	0426	8.6		113.	33.	360.		
18 09 79 1340	0426	8.4		129.	1.4	398.		
18 09 79 1345	0426	8.5		127.	2.2	415.		
02 10 79 1255	0426	8.3		123.	.0	394.		
02 10 79 1300	0426	8.3		121.	.0	433.		
18 10 79 0925	0426	8.3		114.	.0	352.		
18 10 79 0930	0426	8.3		114.	.0	385.		
06 11 79 1325	0426	8.3		142.	.0	432.		
06 11 79 1330	0426	8.3		144.	.0	441.		
27 11 79 0855	0426	8.2		142.	.0	515.		
27 11 79 0900	0426	8.2		151.	.0	481.		
18 12 79 0925	0426	8.0		186.	.0	496.		
18 12 79 0930	0426	8.2		186.	.0	559.		
15 01 80 1055	0426	7.9	46. 53L	194.	.0	532.		3.2
15 01 80 1100	0426	7.9	42. 52L	194.	.0	535.		3.1
05 02 80 0940	0426	7.8		174.	.0	470.		3.4
05 02 80 0945	0426	7.9	39. 52L	172.	.0	498.		3.4
26 02 80 0910	0426	7.9	32. 53L	175.	.0	488.		3.4
26 02 80 0915	0426	8.0	33. 52L	175.	.0	489.		3.4
18 03 80 1325	0426	7.9	26. 53L	120.	.0	451.		2.9
18 03 80 1330	0426	8.2	27. 52L	116.	.0	450.		2.8
01 04 80 0905	0426	8.3		120. 01L	.0	330.	2.5	.8
01 04 80 0910	0426	8.3	21. 52L	120. 01L	.0	327.	2.5	.8
15 04 80 0955	0426	8.4	36. 53L	170. 01L	5.0	581.	3.4	.4
15 04 80 1000	0426	8.4	37. 52L	170. 01L	3.5	570.	3.4	.6
29 04 80 1425	0426	8.0	22. 53F	120. 01L	0.	289.	1.2	4.7
29 04 80 1430	0426	8.0	22.	120. 01L	0.	288.	1.1	4.6
13 05 80 1320	0426	8.2	23. 53L	116. 01L	0.	293.	.8	3.0
13 05 80 1325	0426		23. 52L		.0	312.	1.0	3.0
27 05 80 1355	0426	8.1	22. 53L	111. 01L	0.	312.	1.5	3.9
27 05 80 1400	0426	8.1	22. 52L	110. 01L	0.	310.	1.6	4.0
10 06 80 1330	0426	8.2	22. 52L	109. 01L	.0	274.	.8	3.4
24 06 80 1320	0426	8.4	22.	108. 01L	.0	265.	1.0	3.0
08 07 80 1455	0426	8.6	28.	128. 01L	3.5	336.	1.1	2.2
08 07 80 1500	0426	8.6	28.	128. 01L	3.0	337.	1.1	2.2
22 07 80 1330	0426	8.5	28.	129. 01L	3.0	371.	1.4	1.6
06 08 80 1330	0426	8.6	24.	117. 01L	5.3	313.	2.6	.4

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AD2035 LAT. 48D 42M 37S LONG. 112D 51M 42S PR 3 UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3, ABOVE LETHBRIDGE STP OUTFALL

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
19	08	80	1210	0426	8.4	28.	134. 01L	.0	404.	1.9	1.8
03	09	80	1215	0426	8.4	30.	134. 01L	.1	390.	5.1	2.2
16	09	80	1200	0426	8.4	31.	136. 01L	2.5	403.	2.0	1.9
30	09	80	1600	0426	8.4	29.	126. 01L	1.7	330.	1.1	2.2
15	10	80	1215	0426	8.4	31.	141. 01L	2.0	397.	1.7	1.7
30	10	80	1220	0426	8.6	33.	131. 01L	.5	342.	1.2	2.8
11	11	80	1600	0426	8.4	35.	134. 01L	.2	339.	1.1	2.6
25	11	80	1320	0426	8.2	34.	142. 01L	.0	375.	1.5	2.6
16	12	80	1530	0426	8.2	24.	120. 01L	.0	328.	1.2	3.4
13	01	81	1310	0426	8.3		135. 01L	.0	342.	1.2	3.5
03	02	81	1400	0426	8.2	42.	167. 01L	.0	439.	1.8	3.2
22	02	81	1700	0426	8.2	32.	131. 01L	.0	389.	2.1	3.7
15	03	81	1330	0426	8.4	37.	189. 01L	3.2	433.	1.9	1.2
02	04	81	1400	0426	8.3	46.	168. 01L	.0	503.	2.7	2.4
14	04	81	1430	0426	8.3	38.	169. 01L	.0	464.	1.9	2.6
28	04	81	1330	0426	8.2	27.	120. 01L	.0	294.	1.0	4.8
28	04	81	1335	0426	8.2	26.	120. 01L	.0	290.	1.0	4.7
12	05	81	1315	0426	8.2	31.	129. 01L	.0	321.	1.2	4.2
26	05	81	1630	0426	8.2	28.	116. 01L	.0	276.	.8	5.1
16	06	81	1315	0426	8.2	30.	125. 01L	.0	330.	1.3	5.7
13	07	81	1345	0426	8.3	31.	129. 01L	.0	315.	1.0	3.0
28	07	81	1530	0426	8.6	42.	160. 01L	.5	385.	1.4	4.4
18	08	81	1410	0426	8.7	36.	140. 01L	3.7	355.	1.5	2.6
09	09	81	1200	0426	8.5	34.	147. 01L	.5	400.	1.8	1.4
29	09	81	1400	0426	8.4	25.	147. 01L	.5	438.	2.3	1.0
20	10	81	1515	0426	8.4	32.	159. 01L	.2	462.	2.5	1.2
11	11	81	0900	0426	8.3	25.	151. 01L	.0	393.	1.7	2.2
30	11	81	0830	0426	8.3	44.	181. 01L	.0	505.	2.4	2.4
14	12	81	1300	0426	8.2	44.	189. 01L	.0	477.	2.1	3.2
09	01	82	1600	0426	7.1	77.	331. 01L	.0	1330.	15.	7.8
10	02	82	1130	0426	7.8	45.	180. 01L	.0	432.	2.0	3.8
23	02	82	1430	0426	8.2	37.	145. 01L	.0	414.	2.6	3.2
23	03	82	0930	0426	8.1	39.	155. 01L	.0	425.	2.8	2.8
03	04	82	1030	0426	8.1	37.	155. 01L	.0	453.	3.5	2.8
27	04	82	1400	0426	8.3	31.	145. 01L	.0	372.	2.3	1.9

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
23 05 79 0530	0426	.24	.19	.009 13F	L.003 46F	L.003 66F	.18	.06 19F	L.1
23 05 79 0605	0426	.27	.17	.008	L.003	L.003	.18 51F	.06	L.1
05 06 79 1130	0426	.95	.18	.012 13F	.005 46F	L.003 66F			L.1
05 06 79 1155	0426	.80	.008	.013	.005	L.003	.24 51F	.08	L.1
19 06 79 0920	0426	.048	.038		.010 46F	.008 66F	.15	.06 19F	L.1
19 06 79 0940	0426	.048	.034	.016	.010	.004	.21 51F		L.1
05 07 79 1110	0426	.024	.015	.006 13F	L.003 46F	.006 66F	.12	.01 19F	L.1
05 07 79 1130	0426	.024	.014	.006	L.003	L.003	.21 51F	.02	L.1
18 07 79 0920	0426	.11	.087	.084 13F	.073 46F	.057 66F	.16	.01 19F	L.1
18 07 79 0935	0426	.11	.077	.084	.067	.061	.16 51F	.02	L.1
31 07 79 1400	0426	.066	.038	.042 13F	.022 46F	.010 66F	.19	L.01 19F	L.1
31 07 79 1415	0426	.057	.030	.032	.011	.017	.30 51F	.08	L.1
18 09 79 1155	0426	.20	.18	.18 13F	.17 46F	.16 66F	.36	.02 19F	L.1
18 09 79 1200	0426	.23	.18	.17	.17	.17	.45 51F	.01	L.1
02 10 79 1125	0426	.12	.11	.12 13F	.093 46F	.093 66F	.18	L.01 19F	L.1
02 10 79 1130	0426	.12	.10	.10	.094	.094	.18 51F	.01	L.1
18 10 79 0725	0426	.18	.16	.15 13F	.14 46F	.13 66F	.48	.24 19F	.2
18 10 79 0730	0426	.17	.16	.15	.13	.13	.47 51F	.24	.2
06 11 79 1225	0426	.10	.091	.089 13L	.084 46L	.073 66L	.29 61L	.13 19L	.1
06 11 79 1230	0426	.10	.093	.084 03L	.082 56L	.074 56L	.32 51L	.14 10L	.1
27 11 79 0755	0426	.14	.13	.13 13L	.12 46L	.11 66L	.53 61L	.20 19L	.3
27 11 79 0800	0426	.14	.13			.11 56L	.52 51L	.20 10L	.3
18 12 79 0830	0426	.22	.20	.21 13L	.19 46L	.19 66L	.85 61L	.32 19L	.5
18 12 79 0835	0426	.21	.20	.20 03L	.19 56L	.19 56L	.95 51L	.33 10L	.5
15 01 80 0910	0426	.24	.22	.23 13L	.21 46L	.21 66L	1.1 61L	.60 19L	.7
15 01 80 0915	0426	.24	.23	.23 03L	.21 56L	.21 56L	1.2 51L	.62 10L	.5
05 02 80 0840	0426	.24	.23	.23 13L	.22 46L	.22 66L	1.0 61L	.5 19L	.5
05 02 80 0845	0426	.25	.23	.24 03L	.23 56L	.22 56L	1.1 51L	.46 10L	.4
26 02 80 0810	0426	.26	.24	.23 03L	.22 56L	.22 56L	.91 51L	.46 10L	.4
26 02 80 0815	0426	.26	.24	.23 13L	.22 46L	.22 66L	.87 61L	.45 19L	.4
18 03 80 1145	0426	.23	.20	.16 13L	.14 46L	.13 66L	.78 61L	.25 19L	.2
18 03 80 1150	0426	.25	.22	.16 03L	.12 56L	.12 56L	.70 51L	.24 10L	.2
01 04 80 0815	0426	.16	.14	.097 13L	.087 46L	.070 66L	.32 61L	.09 19L	.1
01 04 80 0820	0426	.18	.15	.094 03L	.086 56L	.075 56L	.35 51L	.08 10L	.1
15 04 80 0825	0426	.23	.21	.17 13L	.16 46L	.15 66L	.40 61L	.10 19L	.1
15 04 80 0830	0426	.20	.18	.16 03L	.15 56L	.13 56L	.43 51L	.11 10L	.1
29 04 80 1155	0426	.23	.17	.042 13F	.035 46F	.017 66F	.31	.10 19F	.2
29 04 80 1200	0426	.23	.18	.054	.041	.030	.37 51F	.13	.2
13 05 80 1155	0426	.080		.026 13L	.025 46L	.017 66L	.15 61L	.04 19L	.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
13 05 80 1200	0426	.086	.077	.026 03L	.019 56L	.006 56L	.16 51L	.02 10L	L.1
27 05 80 1125	0426	3.4	3.1	.004 13L		L.003 66L	.43 61L	.20 19L	.1
27 05 80 1130	0426	3.6		.003 03L	L.003 56L	L.003 56L	.40 51L	.22 10L	.2
10 06 80 1130	0426	.076	.076	.011 03L	.006 56L	L.003 56L	.18 61L	.06 10L	L.1
24 06 80 1130	0426	.060	L.003	.011	.003	L.003	.12	.05	L.1
08 07 80 1230	0426	.070	.067	.052	.046	.040	.13	L.01	L.1
22 07 80 1145	0426	.098	.088	.074	.063	.052	.21	L.01	L.1
06 08 80 1145	0426	.070	.062	.043	.037	.026	.19	.03	L.1
19 08 80 1030	0426	.18	.15	.14	.13	.12	.19	L.01	L.1
03 09 80 1100	0426	.14	.12	.12	.11	.11	.15	L.01	L.1
16 09 80 1045	0426	.13	.12	.098	.095	.093	.26	.01	L.1
30 09 80 1430	0426	.076	.056	.048	.040	.021	.28	.01	.1
15 10 80 1045	0426	.069	.065	.052	.049	.028	.23	.11	L.1
15 10 80 1050	0426	.071	.065	.053	.050	.026	.22	.11	L.1
30 10 80 1130	0426	.057	.046	.020	.015	.012	.18	.06	.1
11 11 80 1435	0426	.043	.024	.019	.012	.007	.17	.07	L.1
25 11 80 1200	0426	.045	.034	.026	.022	.011	.24	.14	L.1
16 12 80 1420	0426	.19	.16	.069	.054	.022	.33	.14	.1
13 01 81 1140	0426	.094	.091	.060		.038	.38	.13	.1
03 02 81 1245	0426	.087	.076	.070	.066	.062	.33	.14	.1
22 02 81 1600	0426	.12	.11	.035	.023	.010	.38	.16	L.1
15 03 81 1230	0426	.090	.089	.070	.070	.067	.28	.04	L.1
02 04 81 1200	0426	.12	.11	.095	.084	.070	.32	.07	L.1
14 04 81 0300	0426	.12	.096	.094	.078	.068	.25	.03	L.1
28 04 81 1200	0426	.11	.093	.043	.033	.020	.30	.10	L.1
12 05 81 1145	0426	.15	.13	.015	.015	.007	.22	.10	L.1
26 05 81 1400	0426	.46	.41	.009	L.003	L.003	.25	.09	L.1
16 06 81 1100	0426	.41	.35	.023	.015	.009	.67	.42	L.1
13 07 81 1155	0426	.022	.013	.004	L.003	L.003	.11	L.01	L.1
28 07 81 1400	0426	.057	.046	.029	.025	.017	.17	L.01	L.1
18 08 81 1300	0426	.087	.072	.057	.056	.042	.15	L.01	L.1
09 09 81 1015	0426	.10	.10	.087		.075	.18	L.01	L.1
29 09 81 1230	0426	.088	.084	.074	.070	.062	.19	.01	L.1
20 10 81 1400	0426	.15	.13	.13	.12	.13	.20	.08	L.1
11 11 81 0800	0426	.096	.085		.071	.052	.18	.05	L.1
30 11 81 1000	0426	.16	.15	.15	.13	.13	.41	.19	.1
14 12 81 1430	0426	.11	.10	.099	.098	.098	.38	.24	L.1
09 01 82 1430	0426	.24	.24	.23	.22	.22	1.0	.38	.8
10 02 82 0900	0426	.36	.33	.31	.31	.30	1.0	.52	.6

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
23 02 82 1400	0426	.15	.14	.14	.13	.12	.63	.45	.2
23 03 82 0800	0426	.12	.11	.11	.10	.10	.47	.31	.2
23 03 82 1000	0426	.13	.12	.11	.11	.098	.48	.31	.1
03 04 82 1120	0426	.099	.089	.076	.062	.051	.40	.14	.1
27 04 82 1250	0426	.10	.087	.050	.037	.037	.22	.03	L.1

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
23 05 79 0530	0426	13.	125.	306.	282.	.52		
23 05 79 0605	0426	13.	105.	286.		.61		
05 06 79 1130	0426	15.	195.	1420.	1340.	1.56		
05 06 79 1155	0426	16.	200.	1650.	1570.	1.1		
19 06 79 0920	0426	16.	23.	26.	25.	.09		
19 06 79 0940	0426	16.	28.	35.	34.	.06		
05 07 79 1110	0426	22.5		6.	L1.	.03		
05 07 79 1130	0426	22.5		6.	4.			
18 07 79 0920	0426	22.5	4.1	1.	L1.	.06		
18 07 79 0935	0426	22.5	4.3	2.	2.			
31 07 79 1400	0426	22.	3.4	17.6	14.4	.08		
31 07 79 1415	0426	22.	3.1	7.0	4.3			
18 09 79 1155	0426		2.6	L1.	L1.	.06		
18 09 79 1200	0426	17.	2.4	L1.				
02 10 79 1125	0426	11.	2.0	2.	L1.	.09		
02 10 79 1130	0426	11.	2.2	3.6	2.			
18 10 79 0725	0426	7.	6.7	3.	3.	.06		
18 10 79 0730	0426	7.	6.8	58.	45.			
06 11 79 1225	0426	3.	2.9	5.	4.	.07 02L		
06 11 79 1230	0426	3.	2.4	4.	4.			
27 11 79 0755	0426	0.	3.6	6.	4.	.07 02L		
27 11 79 0800	0426	0.	1.4	L1.	L1.			
18 12 79 0830	0426	2.	1.1	L1.	L1.	.06 02L		
18 12 79 0835	0426	2.	.9	1.	L1.			

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
15 01 80 0910	0426	0.	1.2	1.	1.	.04 02L	.26 02L	3. 06L
15 01 80 0915	0426	0.	.9	L1.	L1.			3. 04L
05 02 80 0840	0426	0.	1.7	2.	L1.	.06 02L	.23 02L	2. 06L
05 02 80 0845	0426	0.	1.6	L1.	L1.			2. 04L
26 02 80 0810	0426	0.	3.3	9.	7.			1. 04L
26 02 80 0815	0426	0.	2.5	7.	5.	.10 02L	.50 02L	2. 06L
18 03 80 1145	0426	0.	18.0	12.	10.	.24 02L	1.1 02L	4. 06L
18 03 80 1150	0426	0.	24.	14.	9.			4. 04L
01 04 80 0815	0426	0. 61F	14.0	18.	16.	.21 02L	1.0 02L	3. 06L
01 04 80 0820	0426	0. 61F	9.8	26.	22.			4. 04L
15 04 80 0825	0426	7. 61F	1.9	14.	12.	.13 02L	.75 02L	3. 06L
15 04 80 0830	0426	7. 61F	1.8	15.	13.			4. 04L
29 04 80 1155	0426	15. 61F	32.0	163.	149.	.33	3.1	3. 06F
29 04 80 1200	0426	15. 61F	26.0	164.	148.			3.
13 05 80 1155	0426		21.0	59.		.22 02L	1.9 02L	2. 06L
13 05 80 1200	0426		24.0	57.	52.			2. 04L
27 05 80 1125	0426	11. 61F	2100.	5435.	5198.	1.8 02L	15.8 02L	2. 06L
27 05 80 1130	0426	11. 61F	1950.	6244.	5985.			2. 04L
10 06 80 1130	0426	19. 61F	40.0	105.	95.	.12 02L	.82 02L	2. 04L
24 06 80 1130	0426	18. 61F	20.	35.0	25.0	.10	.87	2.
08 07 80 1230	0426		3.8	6.0	5.0	.07	.43	2.
22 07 80 1145	0426		4.8	11.	9.	.13	.71	2.
06 08 80 1145	0426	17.0 61F	5.3	7.	6.	.13	.56	3.
19 08 80 1030	0426	17.0 61F	2.2	4.	3.	.12	.63	2.
03 09 80 1100	0426	15. 61F	1.6	5.	2.	.03	.28	2.
16 09 80 1045	0426	12. 61F	3.5	8.	6.	.13	.66	3.
30 09 80 1430	0426	17. 61F	5.4	9.	6.	.06	.52	2.
15 10 80 1045	0426	8. 61F	3.4	2.	L1.	.08	.31	2.
15 10 80 1050	0426	8. 61F	2.8	3.	2.			2.
30 10 80 1130	0426	6. 61F	11.	18.	15.	.26	1.2	2.
11 11 80 1435	0426	2. 61F	4.4	8.	6.	.07	.45	2.
25 11 80 1200	0426		4.6	8.	6.	.10	.46	1.
16 12 80 1420	0426		38.	120.	110.	.64	4.3	1.
13 01 81 1140	0426	0. 61F	14.	24.	21.	.07	.52	2.
03 02 81 1245	0426		4.0	7.	5.			2.
22 02 81 1600	0426		50.0	94.	88.	.43	2.1	2.
15 03 81 1230	0426		2.5	4.	2.	.12	.54	2.
02 04 81 1200	0426	7.0 61F	4.5	6.	4.	.14	1.3	3.
14 04 81 0300	0426	8.0 61F	2.2	3.	1.	.13	.40	3.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
28 04 81 1200	0426	10.0 61F	46.	101.	94.	.25	1.4	3.
12 05 81 1145	0426	11.0 61F	87.	265.	248.	.31	2.6	3.
26 05 81 1400	0426	13.0 61F	300.	1120.	1080.	.69	7.0	4.
16 06 81 1100	0426	12.0 61F	305.	718.	658.	.84	7.4	6.
13 07 81 1155	0426	19.0 61F	19.	21.	18.	.08	.37	2.
28 07 81 1400	0426	21.0 61F	23.	27.	24.	.10	.66	3.
18 08 81 1300	0426	23. 61F	3.0	4.	3.	.10	.38	2.
09 09 81 1015	0426	18. 61F	1.9	8.	6.	.08	.47	3.
29 09 81 1230	0426	10. 61F	3.2	6.	3.	.07	.27	2.
20 10 81 1400	0426	7.0 61F	6.9	8.	6.	.11	.46	3.
11 11 81 0800	0426	5. 61F	6.0	9.	8.	.08	.47	4.
30 11 81 1000	0426	.0 61F	2.0	2.	1.	.05	.25	3.
14 12 81 1430	0426	.0 61F	1.7	4.0	1.0	.03	.12	2.
09 01 82 1430	0426	.0 61F	2.0	2.	1.	.08	.36	3.
10 02 82 0900	0426	.0 61F	3.6	5.	3.	.08	.41	2.
23 02 82 1400	0426	.0 61F	2.8	2.	1.	.05		3.
23 03 82 0800	0426	5. 61F	5.5	7.	5.	.10	.53	3.
23 03 82 1000	0426	5. 61F	5.7	9.	6.	.09	.49	4.
03 04 82 1120	0426	3.0 61F	8.6	12.	10.	.16	.80	5.
27 04 82 1250	0426	11.0 61F	22.	29.	25.	.32	1.2	4.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
23 05 79 0530	0426	8.1		108.	.0	293.		
23 05 79 0605	0426	8.1		108.	.0	290.		
05 06 79 1130	0426	8.0		100.	.0	270.		
05 06 79 1155	0426	8.0		101.	.0	274.		
19 06 79 0920	0426	8.3		117.	.0	278.		
19 06 79 0940	0426	8.3		117.	.0	278.		
05 07 79 1110	0426	8.5		120.	24.	348.		
05 07 79 1130	0426	8.5		119.	27.	347.		
18 07 79 0920	0426	8.5		128.	6.	423.		

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
18 07 79 0935	0426	8.4		129.		400.		
31 07 79 1400	0426	9.0		88.	.0	357.		
31 07 79 1415	0426	9.0		84.	20.	330.		
18 09 79 1155	0426	8.9		140.	6.0	487.		
18 09 79 1200	0426	8.9		136.	5.4	485.		
02 10 79 1125	0426	8.4		129.	2.4	485.		
02 10 79 1130	0426	8.5		130.	2.3	488.		
18 10 79 0725	0426	8.2		113.	.0	363.		
18 10 79 0730	0426	8.1		112.	.0	364.		
06 11 79 1225	0426	8.2		143.	.0	457.		
06 11 79 1230	0426	8.3		144.	.0	462.		
27 11 79 0755	0426	8.2		148.	.0	518.		
27 11 79 0800	0426	8.2		151.	.0	513.		
18 12 79 0830	0426	7.9		180.	.0	590.		
18 12 79 0835	0426	7.8		181.	.0	586.		
15 01 80 0910	0426	7.8	52. 53L	212.	.0	557.		2.3
15 01 80 0915	0426	7.8	46. 52L	212.	.0	559.		3.1
05 02 80 0840	0426	7.7	42. 53L	180.	0.	541.		2.4
05 02 80 0845	0426	7.7	41. 52L	177.	.0	540.		2.4
26 02 80 0810	0426	7.9	33. 52L	181.	.0	532.		3.5
26 02 80 0815	0426	7.8	33. 53L	181.	.0	533.		3.7
18 03 80 1145	0426	8.0	26. 53L	115.	.0	456.		2.8
18 03 80 1150	0426	7.9	25. 52L	111.	.0	456.		2.8
01 04 80 0815	0426	8.3	13. 53L	120. 01L	.0	326.	3.8	.6
01 04 80 0820	0426	8.2	20. 52L	100. 01L	.0	320.	3.8	.7
15 04 80 0825	0426	8.3	36. 53L	160. 01L	.0	548.	4.8	.3
15 04 80 0830	0426	8.4	37. 52L	160. 01L	5.6	576.	4.9	.5
29 04 80 1155	0426	7.9	23. 53F	120. 01L	0.	318.	2.9	4.5
29 04 80 1200	0426	7.8	23.	120. 01L	0.	325.	1.7	4.5
13 05 80 1155	0426	8.3	23. 53L	114. 01L	0.	290.	1.5	3.0
13 05 80 1200	0426	8.3	24. 52L	115. 01L	0.	293.	1.5	3.0
27 05 80 1125	0426	8.1	23. 53L	117. 01L	0.	349.	1.3	4.2
27 05 80 1130	0426	8.1	23. 52L	115. 01L	0.	344.	1.3	4.3
10 06 80 1130	0426	8.3	22. 52L	111. 01L	.0	275.	1.0	3.6
24 06 80 1130	0426	8.5	22.	106. 01L	.0	263.	1.0	3.9
08 07 80 1230	0426	8.9	27.	127. 01L	5.9	349.	2.9	1.0
22 07 80 1145	0426	8.7	27.	131. 01L	3.0	389.	3.8	.9
06 08 80 1145	0426	8.8	24.	118. 01L	5.6	336.	2.6	.6
19 08 80 1030	0426	8.6	28.	140. 01L	.0	440.	6.4	1.0

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AD2050 LAT. 49D 51M 30S LONG. 112D 37M 24S PR 3 UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845, BELOW LETHBRIDGE (BELOW PICTURE BUTTE)

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
03 09 80 1100	0426	8.9	28.	137. 01L	5.2	410.	4.8	.6
16 09 80 1045	0426	8.6	30.	134. 01L	3.4	409.	5.2	.8
30 09 80 1430	0426	8.6	29.	126. 01L	1.8	343.	3.2	.8
15 10 80 1045	0426	8.2	32.	142. 01L	.0	414.	3.1	.3
15 10 80 1050	0426	8.3	33.	142. 01L	.0	415.	3.0	.2
30 10 80 1130	0426	8.3		133. 01L	.0	355.	3.8	1.9
11 11 80 1435	0426	8.4	35.	134. 01L	1.0	354.	2.0	1.1
25 11 80 1200	0426	8.3	34.	145. 01L	.0	383.	2.4	1.7
16 12 80 1420	0426	8.0	26.	120. 01L	.0	348.	2.6	2.9
13 01 81 1140	0426	8.3		135. 01L	.0	362.	2.6	3.6
03 02 81 1245	0426	8.2	43.	170. 01L	.0	466.	3.4	2.9
22 02 81 1600	0426	8.1	31.	129. 01L	.0	389.	3.1	3.5
15 03 81 1230	0426	8.6	44.	155. 01L	6.0	442.	4.9	.4
02 04 81 1200	0426	8.3	46.	169. 01L	.0	511.	5.5	.9
14 04 81 0300	0426	8.7	38.	171. 01L	7.0	540.	3.5	.7
28 04 81 1200	0426	8.2	27.	121. 01L	.0	307.	1.8	4.6
12 05 81 1145	0426	8.2	31.	133. 01L	.0	328.	1.6	4.6
26 05 81 1400	0426	8.2	28.	129. 01L	.0	280.	1.0	4.9
16 06 81 1100	0426	8.2	30.	124. 01L	.0	340.	1.6	6.3
13 07 81 1155	0426	8.6	31.	132. 01L	2.7	315.	1.7	2.6
28 07 81 1400	0426	8.6	42.	154. 01L	.5	387.	2.5	3.2
18 08 81 1300	0426	8.9	34.	141. 01L	3.6	375.	4.3	1.1
09 09 81 1015	0426	8.6	34.	147. 01L	1.5	420.	3.8	.1
29 09 81 1230	0426	8.7	25.	150. 01L	3.7	476.	7.7	L.1
20 10 81 1400	0426	8.6	33.	160. 01L	1.4	500.	6.9	.6
11 11 81 0800	0426	8.3	26.	150. 01L	.0	399.	3.9	.3
30 11 81 1000	0426	8.4	47.	195. 01L	.2	536.	10.	.4
14 12 81 1430	0426	8.2	45.	193. 01L	.0	512.	6.2	1.2
09 01 82 1430	0426	7.8	53.	235. 01L	.0	594.	12.	3.8
10 02 82 0900	0426	7.7	47.	185. 01L	.0	483.	7.7	4.0
23 02 82 1400	0426	8.1	38.	150. 01L	.0	424.	4.5	3.2
23 03 82 0800	0426	8.0	39.	155. 01L	.0	437.	5.7	2.4
23 03 82 1000	0426	8.1	39.	155. 01L	.0	446.	5.7	2.4
03 04 82 1120	0426	8.1	36.	155. 01L	.0	452.	5.7	2.2
27 04 82 1250	0426	8.4	33.	150. 01L	.2	397.	4.4	1.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 05 79 1615	0426	.23	.13		L.003 46F	L.003 66F	.24	.08 19F	L.1
22 05 79 1700	0426	.23	.13		L.003	L.003	.23 51F	.09	L.1
05 06 79 0840	0426	.46	.29	.012 13F	.004 46F	L.003 66F	.21	.09 19F	L.1
05 06 79 0915	0426	.27	.27	.013	.004	.006	.20 51F	.08	L.1
19 06 79 0715	0426	.065	.062		.008 46F	.010 66F	.17	.07 19F	L.1
19 06 79 0735	0426	.072	.068			L.003	.16 51F	.07	L.1
05 07 79 0830	0426	.023	.012	.004 13F	L.003 46F	L.003 66F	.13	.01 19F	L.1
05 07 79 0850	0426	.023	.009	.005	L.003	L.003	.35 51F	.14	L.1
18 07 79 0700	0426	.022	.010	.006 13F	L.003 46F	L.003 66F	.17	.02 19F	L.1
18 07 79 0715	0426	.022	.010	L.003	L.003	L.003	.15 51F	.02	L.1
31 07 79 1105	0426	.020	.011	.013 13F	.003 46F	L.003 66F	.19	L.01 19F	L.1
31 07 79 1115	0426	.019	.011	.010	L.003	L.003	.22 51F	.04	L.1
18 09 79 0910	0426	.018	.016	.012 13F	.006 46F	.003 66F	.25	.03 19F	L.1
18 09 79 0915	0426	.019	.015	.011		.008	.25 51F	L.01	L.1
02 10 79 0825	0426	.030	.009	.006 13F	.004 46F	.003 66F	.22	L.01 19F	L.1
02 10 79 0830	0426	.018	.013	.009	L.003	L.003	.22 51F	L.01	L.1
17 10 79 1600	0426	.055	.039	.024 13F	.013 46F	.013 66F	.21	L.01 19F	L.1
17 10 79 1630	0426	.052	.038	.018	.014	.013	.20 51F	L.01	L.1
06 11 79 0955	0426	.035	.030	.026 13L	.029 46L	.021 66L	.20 61L	.05 19L	L.1
06 11 79 1000	0426	.034	.031	.025 03L	.024 56L	.022 56L	.22 51L	.05 10L	L.1
26 11 79 1525	0426	.044	.044	.030 13L	.030 46L	.022 66L	.41 61L	.19 19L	L.1
26 11 79 1530	0426	.045	.037	.037 03L	.028 56L	.022 56L	.40 51L	.20 10L	L.1
17 12 79 1425	0426	.071	.067	.071 13L	.061 46L	.059 66L	1.0 61L	.44 19L	.7
17 12 79 1430	0426	.074	.065	.067 03L	.060 56L	.060 56L	1.0 51L	.46 10L	.4
14 01 80 1530	0426	.065	.054	.057 13L	.047 46L	.047 66L	1.1 61L	.72 19L	.4
14 01 80 1535	0426	.063	.054	.057 03L	.048 56L	.047 56L	1.2 51L	.70 10L	.3
04 02 80 1610	0426	.093	.086	.088 13L	.076 46L	.074 66L	.80 61L	.6 19L	L.1
04 02 80 1615	0426	.093	.083	.091 03L	.080 56L	.079 56L	.90 51L	.60 10L	L.1
25 02 80 1705	0426	.23	.22	.22 13L	.21 46L	.21 66L	1.1 61L	.66 19L	.5
25 02 80 1710	0426	.23	.22	.22 03L	.21 56L	.21 56L	1.2 51L	.64 10L	.4
18 03 80 0825	0426	.13	.12	.11 13L	.10 46L	.090 66L	.74 61L	.40 19L	.2
18 03 80 0830	0426	.14	.12	.11 03L	.091 56L	.089 56L	.78 51L	.28 10L	.2
31 03 80 1715	0426	.075	.065	.055 13L	.045 46L	.035 66L	.36 61L	.09 19L	L.1
31 03 80 1720	0426	.077	.061	.049 03L	.045 56L	.032 56L	.33 51L	.09 10L	L.1
14 04 80 1710	0426	.11	.085	.079 13L	.063 46L	.057 66L	.27 61L	.01 19L	L.1
14 04 80 1715	0426	.12	.087	.073 03L	.060 56L	.060 56L	.27 51L	.01 10L	L.1
29 04 80 0825	0426	.20	.17	.053 13F	.045 46F	.042 66F	.36	.15 19F	.2
29 04 80 0830	0426	.27	.18	.052	.030	.030	.49 51F	.23	.2
13 05 80 0905	0426	.11	.11	.014 13L	.013 46L	.006 66L	.21 61L	.10 19L	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
13 05 80 0910	0426	.11	.095	.016 03L	.009 56L	.006 56L		.06 10L	L.1
27 05 80 0740	0426	.85	1.0	.008 13F	.008 46F	.003 66F	.30	.17 19F	L.1
27 05 80 0745	0426	.85	.97	.009	.009	.003	.31 51F	.17	L.1
10 06 80 0830	0426	.095	.092	.012 03L	.004 56L	L.003 56L	.24 61L	.09 10L	L.1
24 06 80 0915	0426	.069	L.003	.010	.003	L.003	.14	.07	L.1
08 07 80 0830	0426	.021	.015	.010	.004	.004	.13	.01	L.1
15 07 80 1325	0426	.022	.013	.009 03L	.007 56L	L.003 56L	.21 61L	L.01 10L	L.1
22 07 80 0855	0426	.012	.012	.004	.003	L.003	.21	.01	L.1
22 07 80 0900	0426	.011	.011	L.003	L.003	L.003	.33	L.01	L.1
06 08 80 0930	0426	.033	.017	.011	.007	L.003	.31	L.01	L.1
19 08 80 0820	0426	.023	.013	.009	.009	L.003	.24	L.01	L.1
03 09 80 0900	0426	.015	.010	.009	.004	.003	.18	L.01	L.1
08 09 80 1510	0426	.018	.007	.011 03L	.004 56L	.003 56L	.24 61L	L.01 10L	L.1
16 09 80 0830	0426	.026	.014	.011	.004	L.003	.48	L.01	L.1
30 09 80 0830	0426	.062	.031	.027	.016	L.003	.38	.01	L.1
15 10 80 0830	0426	.035	.035	.023	.019	.003	.18	L.01	L.1
30 10 80 0930	0426	.030	.021	.006	.003	L.003	.11	L.01	L.1
11 11 80 1045	0426	.019	.013	.009	L.003	L.003	.13	.02	L.1
25 11 80 0930	0426	.018	.013	.006	.003	L.003	.21	.12	L.1
13 01 81 0900	0426	.041	.041	.022	.022	.007	.32	.16	.1
03 02 81 1030	0426	.010	.006	.003	L.003	L.003	.26	.10	L.1
22 02 81 1200	0426	.073	.063	.015	.012	.004	.27	.13	L.1
15 03 81 1020	0426	.070	.059	.040	.035	.028	.23	L.01	L.1
02 04 81 0930	0426	.095	.088	.049	.040	.028	.23	.01	L.1
14 04 81 1015	0426	.11	.089	.067	.055	.045	.23	L.01	L.1
28 04 81 0830	0426	.14	.12	.037	.021	.020	.16	L.01	L.1
12 05 81 0830	0426	.27	.23	.012	.010	.003	.12	.19	.1
26 05 81 0930	0426	.35	.33	.013	L.003	L.003	.30	.10	L.1
15 06 81 1615	0426	.31	.31	.015	.004	.003	.55	.17	L.1
15 06 81 1820	0426	.24	.24	.010	.006	L.003	.27	.17	L.1
07 07 81 0715	0426	.020	.019	.010	L.003	L.003	.11	L.01	L.1
21 07 81 1700	0426	.029	.017	.008	.005	.004	.14	L.01	L.1
28 07 81 1030	0426	.027	.023	.006	.005	L.003	.15	L.01	L.1
18 08 81 1030	0426	.019	.015	.008	L.003	L.003	.19	L.01	L.1
01 09 81 0645	0426	.026	.008	.012	.007	L.003	.25	.01	L.1
09 09 81 0800	0426	.024	.015	.010	L.003	L.003	.22	L.01	L.1
29 09 81 1010	0426	.024	.014	.011	.008	L.003	.24	L.01	L.1
20 10 81 1210	0426	.054	.045	.025	.024	.015	.20	.01	L.1
10 11 81 1530	0426	.040	.027	.025	.007	L.003	.14	L.01	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSFHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
30 11 81 1245	0426	.021	.010	.010	.004	.003	.25	.06	L.1
14 12 81 1600	0426	.038	.035	.033	.033	.028	.49	.34	L.1
09 01 82 1400	0426	.050	.033	.019	.011	.007	.75	.39	L.1
09 02 82 1400	0426	.32	.30	.29	.29	.28	1.1	.74	.2
23 02 82 1140	0426	.20	.19	.19	.18	.17	.79	.62	.2
22 03 82 1630	0426	.10	.087	.086	.079	.071	.47	.28	.1
03 04 82 1340	0426	.090	.061	.049	.026	.004	.32	L.01	L.1
27 04 82 1100	0426	.13	.11	.025	.021	.020	.25	L.01	L.1

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
22 05 79 1615	0426	16.	130.	298.	278.	.58		
22 05 79 1700	0426	16.	125.	294.	266.	.53		
05 06 79 0840	0426	16.	125.	623.	587.	1.1		
05 06 79 0915	0426	16.	125.	439.	408.	1.2		
19 06 79 0715	0426	16.5	59.	75.	73.	.07		
19 06 79 0735	0426	16.5	56.	73.	70.	.08		
05 07 79 0830	0426	19.5		12.	9.	.09		
05 07 79 0850	0426	19.5		12.	9.			
18 07 79 0700	0426	21.	4.4	6.	5.	.05		
18 07 79 0715	0426	21.	5.3	4.	3.			
31 07 79 1105	0426	23.5	2.4	L1.	L1.	.04		
31 07 79 1115	0426	23.5	2.2	4.6	L1.			
18 09 79 0910	0426	14.	2.5	L1.		.09		
18 09 79 0915	0426		2.8	3.	L1.			
02 10 79 0825	0426	10.	2.8	2.	L1.	.12		
02 10 79 0830	0426	10.	3.1	5.	3.			
17 10 79 1600	0426	10.	5.9	6.	1.	.33		
17 10 79 1630	0426	10.	5.8	10.	8.			
06 11 79 0955	0426	0.	4.3	4.	3.	.07 02L		
06 11 79 1000	0426	0.	2.1	4.	3.			
26 11 79 1525	0426	0.	1.5	2.	L1.	.10 02L		

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AG2095   LAT. 49D 51M 25 LONG. 111D 41M 48S   PR 3   UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
26 11 79 1530	0426	0.	1.8	L1.	L1.			
17 12 79 1425	0426	2.	.8	L1.	L1.	.06 02L		
17 12 79 1430	0426	2.	.7	2.	2.			
14 01 80 1530	0426	0.	.7	2.	2.	.05 02L	.25 02L	3. 06L
14 01 80 1535	0426	0.	.7	L1.	L1.			3. 04L
04 02 80 1610	0426	0.	.7	L1.	L1.	.04 02L	.19 02L	
04 02 80 1615	0426	0.	.6	L1.	L1.			
25 02 80 1705	0426	.5	1.3	L1.	L1.	.04 02L	.19 02L	2. 06L
25 02 80 1710	0426	.5	1.4	L1.	L1.			2. 04L
18 03 80 0825	0426	0.	5.5	3.	1.	.09 02L	.41 02L	3. 06L
18 03 80 0830	0426	0.	4.4	3.	1.			3. 04L
31 03 80 1715	0426	0. 61F	6.1	4.	4.	.09 02L	.37 02L	3. 06L
31 03 80 1720	0426	0. 61F	6.6	4.	4.			4. 04L
14 04 80 1710	0426	7. 61F	1.3	3.	2.	.14 02L	.87 02L	3. 06L
14 04 80 1715	0426	7. 61F	1.2	4.	4.			3. 04L
29 04 80 0825	0426	16. 61F	32.0	103.	92.	.50	3.8	3. 06F
29 04 80 0830	0426	16. 61F	27.0	119.	104.			4.
13 05 80 0905	0426		35.0	108.				2. 06L
13 05 80 0910	0426		46.0	103.	95.			2. 04L
27 05 80 0740	0426	13. 61F	460.	989.	928.	.91	8.7	2. 06F
27 05 80 0745	0426	13. 61F	440.	1022.	966.			2.
10 06 80 0830	0426	17. 61F	49.0	122.	111.	.18 02L	.95 02L	3. 04L
24 06 80 0915	0426	17. 61F	30.	71.0	63.0	.16	1.3	2.
08 07 80 0830	0426		4.5	6.0	5.0	.06	.44	2.
15 07 80 1325	0426	20.5 61F		3.	2.	.07 02L	.34 02L	2. 04L
22 07 80 0855	0426	24.0 61F	3.8	7.	6.	.13	.53	3.
22 07 80 0900	0426	24.0 61F	2.3	4.	3.			3.
06 08 80 0930	0426	16.0 61F	7.5	7.	6.	.14	.58	4.
19 08 80 0820	0426	17.0 61F	3.1	4.	3.	.08	.48	3.
03 09 80 0900	0426	14. 61F	3.4	4.	2.	.05	.33	3.
08 09 80 1510	0426	18.2 61F		2.	L1.	.06 02L	.36 02L	2. 04L
16 09 80 0830	0426	11.5 61F	4.5	6.	5.	.12	.63	3.
30 09 80 0830	0426	17. 61F	6.8	11.	6.	.15	.91	3.
15 10 80 0830	0426	9. 61F	4.6	6.	4.	.11	.39	2.
30 10 80 0930	0426	5. 61F	10.	19.	16.	.20	.94	2.
11 11 80 1045	0426	0. 61F	5.2	8.	7.	.07	.41	2.
25 11 80 0930	0426	.0 61F	4.5	6.	4.	.10	.46	2.
13 01 81 0900	0426	0. 61F	9.5	14.	12.	.05	.34	2.
03 02 81 1030	0426		3.2	L1.	L1.			2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
22 02 81 1200	0426		18.0	36.	33.	.29	1.2	1.
15 03 81 1020	0426		4.3	10.	8.	.17	.80	3.
02 04 81 0930	0426	5.0 61F	4.5	9.	8.	.16	.68	3.
14 04 81 1015	0426	4.0 61F	5.1	9.	7.	.18	.68	3.
28 04 81 0830	0426	12.0 61F	36.	115.	101.	.22	1.2	4.
12 05 81 0830	0426	9.0 61F	209.	510.	470.	.52	4.4	1.
26 05 81 0930	0426	13.0 61F	320.	1236.	1192.	.55	5.0	4.
15 06 81 1815	0426	13.0 61F	270.	1334.	1264.	.62	6.4	3.
15 06 81 1820	0426	13.0 61F	270.	1308.	1232.	.42	3.0	3.
07 07 81 0715	0426	20.0 61F		15.	12.	.06	.25	2.
21 07 81 1700	0426	22. 61F	15.	15.		.08	.55	2.
28 07 81 1030	0426	21.0 61F	25.	23.	20.	.11	.66	3.
18 08 81 1030	0426	22. 61F	2.9	4.	2.	.08	.33	3.
01 09 81 0645	0426	15. 61F		5.	3.			3.
09 09 81 0800	0426	18. 61F	1.9	5.	3.	.11	.57	3.
29 09 81 1010	0426	8. 61F	4.8	3.	1.	.10	.41	3.
20 10 81 1210	0426	5.0 61F	8.7	10.	8.	.14	.66	3.
10 11 81 1530	0426		6.5	8.	6.	.09	.52	4.
30 11 81 1245	0426	.0 61F	2.4	1.	1.	.04	.11	4.
14 12 81 1600	0426	.0 61F	2.0	4.0	3.0	.04	.20	3.
09 01 82 1400	0426	.0 61F	1.1	1.	L1.	.14	.72	5.
09 02 82 1400	0426	.0 61F	1.6	3.	2.	.04	.25	3.
23 02 82 1140	0426	.0 61F	2.8	2.	1.	.07		4.
22 03 82 1630	0426	4. 61F	2.5	1.	L1.	.09	.50	4.
03 04 82 1340	0426	3.0 61F	3.0	2.	L1.	.19	.96	8.
27 04 82 1100	0426	10.0 61F	16.	37.	31.	.43	2.3	4.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
22 05 79 1615	0426	8.1		110.	.0	297.		
22 05 79 1700	0426	8.1		110.	.0	299.		
05 06 79 0840	0426	8.1		110.	.0	296.		
05 06 79 0915	0426	8.1		109.	.0	296.		
19 06 79 0715	0426	8.2		117.	.0	298.		
19 06 79 0735	0426	8.2		117.	.0	298.		
05 07 79 0830	0426	8.4		123.		396.		
05 07 79 0850	0426	8.3		124.	.0	396.		
18 07 79 0700	0426	8.4		117.		412.		
18 07 79 0715	0426	8.4		118.		421.		
31 07 79 1105	0426	8.7		109.	6.	429.		
31 07 79 1115	0426	8.7		107.	31.	414.		
18 09 79 0910	0426	8.6		126.	1.5	510.		
18 09 79 0915	0426	8.6		123.	.8	507.		
02 10 79 0825	0426	8.4		120.	3.0	508.		
02 10 79 0830	0426	8.4		121.	2.8	514.		
17 10 79 1600	0426	8.5		117.	1.1	418.		
17 10 79 1630	0426	8.3		117.	.0	422.		
06 11 79 0955	0426	8.2		152.	.0	528.		
06 11 79 1000	0426	8.2		152.	.0	530.		
26 11 79 1525	0426	8.2		151.	.0	571.		
26 11 79 1530	0426	8.3		156.	.0	549.		
17 12 79 1425	0426	8.1		208.	.0	685.		
17 12 79 1430	0426	8.1		209.	.0	684.		
14 01 80 1530	0426	7.8	52. 53L	224.	.0	560.		.2
14 01 80 1535	0426	7.8	47. 52L	220.	.0	561.		.4
04 02 80 1610	0426	7.9		192.	.0	590.		.3
04 02 80 1615	0426	7.9	45. 52L	197.	.0	589.		.2
25 02 80 1705	0426	7.7	35. 53L	195.	.0	577.		1.4
25 02 80 1710	0426	7.8	36. 52L	195.	.0	576.		1.6
18 03 80 0825	0426	7.9	31. 53L	135.	.0	530.		2.5
18 03 80 0830	0426	7.9	31. 52L	132.	.0	529.		2.2
31 03 80 1715	0426	8.6	17. 53L	110. 01L	3.6	353.	4.8	.6
31 03 80 1720	0426	8.6	18. 52L	110. 01L	5.3	353.	4.8	.7
14 04 80 1710	0426	8.7	34. 53L	160. 01L	9.4	572.	6.6	.8
14 04 80 1715	0426	8.7	37. 52L	160. 01L	11.	574.	6.4	.5
29 04 80 0825	0426	7.9	24. 53F	130. 01L	0.	350.	2.5	3.7
29 04 80 0830	0426	7.9	24.	130. 01L	0.	412.	1.5	3.2
13 05 80 0905	0426	7.8	22. 53L	108. 01L	0.	312.	1.3	3.4

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
13 05 80 0910	0426	8.1	23. 52L	115. 01L	0.	297.	1.4	3.8
27 05 80 0740	0426	8.1	22. 53F	107. 01L	0.	295.	1.6	4.1
27 05 80 0745	0426	8.1	22.	105. 01L	0.	306.	1.5	4.3
10 06 80 0830	0426	8.2	22. 52L	118. 01L	.0	286.	.9	3.7
24 06 80 0915	0426	8.4	22.	108. 01L	.0	282.	1.2	3.2
08 07 80 0830	0426	8.6	27.	126. 01L	2.8	382.	3.7	1.0
15 07 80 1325	0426	8.7	26. 52L	124. 01L	6.8	412.	4.9	.7
22 07 80 0855	0426	8.6	25.	117. 01L	2.5	420.	5.1	.7
22 07 80 0900	0426	8.5	25.	117. 01L	1.5	421.	5.1	.8
06 08 80 0930	0426	8.6	25.	129. 01L	1.7	478.	10.	.1
19 08 80 0820	0426	8.6	24.	112. 01L	.0	449.	6.0	.4
03 09 80 0900	0426	8.6	24.	114. 01L	1.7	427.	7.3	.6
08 09 80 1510	0426	8.8	24. 52L	115. 01L	8.6	426.	4.3	.2
16 09 80 0830	0426	8.4	29.	129. 01L	.7	448.	4.8	.5
30 09 80 0830	0426	8.3	32.	141. 01L	.0	429.	4.2	.2
15 10 80 0830	0426	8.5	31.	137. 01L	3.5	434.	5.7	.6
30 10 80 0930	0426	8.4		143. 01L	3.0	415.	3.4	1.5
11 11 80 1045	0426	8.5	35.	132. 01L	2.0	367.	3.2	.4
25 11 80 0930	0426	8.3	34.	148. 01L	.0	432.	4.8	.7
13 01 81 0900	0426	8.2		145. 01L	.0	383.	2.5	3.8
03 02 81 1030	0426	8.0	43.	167. 01L	.0	494.	4.4	2.2
22 02 81 1200	0426	8.1	30.	122. 01L	.0	375.	3.3	2.5
15 03 81 1020	0426	8.3	46.	164. 01L	.0	491.	5.2	.3
02 04 81 0930	0426	8.2	46.	170. 01L	.0	568.	6.3	.6
14 04 81 1015	0426	8.5	38.	176. 01L	4.0	544.	7.2	.2
28 04 81 0830	0426	8.2	34.	152. 01L	.0	399.	2.9	3.8
12 05 81 0830	0426	8.0	32.	134. 01L	.0	354.	1.9	4.9
26 05 81 0930	0426	8.2	28.	121. 01L	.0	292.	.9	5.0
15 06 81 1815	0426	8.2	29.	118. 01L	.0	325.	1.3	4.2
15 06 81 1820	0426	8.1	25.	118. 01L	.0	332.	1.3	4.4
07 07 81 0715	0426	8.5	31.	126. 01L	3.6	308.	1.2	2.8
21 07 81 1700	0426	8.8	33.	140. 01L	3.5	286.	3.4	1.6
28 07 81 1030	0426	8.5	38.	140. 01L	.2	396.	3.4	2.3
18 08 81 1030	0426	8.7	29.	124. 01L	2.9	382.	5.0	.6
01 09 81 0645	0426	8.6	31.	125. 01L	.2	420.	6.6	.6
09 09 81 0800	0426	8.6	29.	126. 01L	.2	434.	7.0	.2
29 09 81 1010	0426	8.5	24.	140. 01L	.2	496.	6.5	.6
20 10 81 1210	0426	8.4	31.	151. 01L	.2	525.	8.4	1.0
10 11 81 1530	0426	8.5	25.	144. 01L	.2	407.	3.8	.4

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AG2095 LAT. 49D 51M 2S LONG. 111D 41M 48S PR 3 UTM 12 449950E 5522050N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
30 11 81 1245	0426	8.4	45.	185. 01L	.2	556.	5.6	.1
14 12 81 1600	0426	8.2	48.	202. 01L	.0	553.	5.9	.6
09 01 82 1400	0426	7.4	61.	269. 01L	.0	702.	12.	1.4
09 02 82 1400	0426	7.5	53.	205. 01L	.0	527.	7.5	4.0
23 02 82 1140	0426	8.0	38.	160. 01L	.0	424.	8.7	2.9
22 03 82 1630	0426	8.0	36.	145. 01L	.0	448.	7.2	1.6
03 04 82 1340	0426	7.6	38.	155. 01L	.0	494.	5.7	1.4
27 04 82 1100	0426	8.4	31.	160. 01L	1.0	482.	5.7	.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
15 05 79 1820	0426	.12	.084	.12 13F	.017 46F	.013 66F	.31	.09 19F	L.1
15 05 79 1855	0426	.14	.113	.022	.014	.013	.28 51F	.05	L.1
29 05 79 1430	0426	.18	.15	.021 13F	.01 46F	.008 66F	.19	.05 19F	L.1
29 05 79 1431	0426	.18	.16	.016	.016	.006	.19 51F	.05	L.1
12 06 79 1420	0426	.15	.11	.048 13F	.024 46F	.037 66F	.45	.30 19F	L.1
12 06 79 1500	0426	.14	.11	.048	.036	.036	.50 51F	.30	L.1
26 06 79 1245	0426	.077	.050	.024 13F	.016 46F	.010 66F	.29	.10 19F	L.1
26 06 79 1300	0426	.061	.020	.024	.016	.012	.29 51F	.11	L.1
10 07 79 1150	0426	.070	.048	.039 13F	.036 46F	.029 66F	.26	L.01 19F	L.1
10 07 79 1215	0426	.07	.047	.039	.036	.031	.28 51F	.02	L.1
24 07 79 1225	0426	.023	.011	.023 13F	.010 46F	.006 66F	.28	.03 19F	L.1
24 07 79 1235	0426	.032	.012	.022	.014	.012	.40 51F		L.1
06 08 79 1300	0426	.028	.016	.014 13F	.008 46F	.003 66F	.32	.02 19F	L.1
06 08 79 1305	0426	.025	.011	.017	.009	L.003	.28 51F	.01	L.1
21 08 79 1425	0426	.032	.019	.022 13F	.008 46F	L.003 66F	.39	L.01 19F	L.1
21 08 79 1435	0426	.030	.011	.029	.007	L.003	.45 51F	L.01	L.1
25 09 79 0740	0426	.023	.007	.016 13F	.006 46F	L.003 66F	.25	L.01 19F	L.1
25 09 79 0745	0426	.021	.008	.010	L.003	L.003	.25 51F	L.01	L.1
10 10 79 0655	0426	.036	.021	.020 13F	.006 46F	.003 66F	.27	L.01 19F	L.1
10 10 79 0700	0426	.035	.019	.015	.007	.003	.31 51F	.01	L.1
30 10 79 0755	0426	.015	.009	.011 13F	.005 46F	L.003 66F	.62	.36 19F	L.1
30 10 79 0800	0426	.014	.006	.010	.005	L.003	.66 51F	.39	L.1
19 11 79 1525	0426	.092	.084	.065 13L	.054 46L	.052 66L	1.5 61L	1.3 19L	L.1
19 11 79 1530	0426	.11	.083	.066 03L	.055 56L	.052 56L	1.7 51L	1.3 10L	L.1
10 12 79 1540	0426	.18	.17	.16 13L	.15 46L	.15 66L	3.1 61L	1.7 19L	1.4
10 12 79 1545	0426	.19	.16	.16 03L	.14 56L	.14 56L	3.0 51L	1.65 10L	1.4
08 01 80 1415	0426	.15	.14	.13 13L	.13 46L	.12 66L	1.8 61L	1.4 19L	.4
08 01 80 1420	0426	.15	.13	.14 03L	.13 56L	.12 56L	1.8 51L	1.4 10L	.4
29 01 80 1340	0426	.17	.16	.15 13L	.14 46L	.14 66L	1.6 61L	1.4 19L	.5
29 01 80 1345	0426	.17	.15	.15 03L	.15 56L	.14 56L	1.6 51L	1.4 10L	.5
19 02 80 1315	0426	.14	.11	.12 13L	.11 46L	.11 66L	1.5 61L	1.3 19L	.2
19 02 80 1320	0426	.14	.13	.12 03L	.12 56L	.11 56L	1.5 51L	1.3 10L	.2
11 03 80 1325	0426	.22	.21	.18 13L	.17 46L	.16 66L	1.6 61L	1.1 19L	.5
11 03 80 1330	0426	.22	.21	.19 03L	.18 56L	.18 56L	1.9 51L	1.4 10L	.5
25 03 80 1135	0426	.16	.15	.16 13L	.15 46L	.15 66L	1.6 61L	1.1 19L	.5
25 03 80 1140	0426	.16	.16	.16 03L	.15 56L	.15 56L	1.6 51L	1.1 10L	.3
09 04 80 1345	0426	.37	.33	.043 13L	.033 46L	.028 66L	1.6 61L	.70 19L	.6
09 04 80 1350	0426	.39	.28	.045 03L	.029 56L	.028 56L	1.3 51L	.74 10L	.6
22 04 80 1525	0426	.36	.31	.098 13F	.087 46F	.075 66F	1.3	1.4 19F	

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 04 80 1530	0426	.36	.32	.10	.081	.064	1.9 51F	1.1	.5
06 05 80 1320	0426	.15	.036	.15 13F	.033 46F	.033 66F	.32	.16 19F	
06 05 80 1325	0426	.15	.044	.12	.023	.030	.30 51F	.16	L.1
22 05 80 1110	0426	.072		.026 13F	.012 46F	.005 66F	.33	.04 19F	L.1
22 05 80 1115	0426	.073		.028	.010	.008	.27 51F	L.01	L.1
04 06 80 1100	0426	.25	.21	.032 03L	.021 56L	.027 56L	.53 61L	.36 10L	.1
18 06 80 0755	0426	.17	.13	.037	.037	.030	.66	.58	L.1
18 06 80 0800	0426	.18	.16	.035	.030	.025	.50	.40	L.1
02 07 80 1545	0426	.057	L.003	.018	L.003	L.003	.29	.18	.1
16 07 80 0635	0426	.019	.010	.009 03L	.005 56L	L.003 56L	.25 61L	L.01 10L	L.1
16 07 80 0820	0426	.019	.013	.009	.005	L.003	.26	L.01	L.1
30 07 80 0830	0426	.018	.009	.015	L.003	L.003	.35	L.01	L.1
13 08 80 0730	0426	.030	.007	.012	L.003	L.003	.21	L.01	L.1
26 08 80 1630	0426	.028	.016	.007	L.003	L.003	.21	L.01	L.1
09 09 80 0830	0426	.021	.011	.011 03L	.003 56L	L.003 56L	.27 61L	L.01 10L	L.1
09 09 80 1510	0426	.020	.009	.012	.004	L.003	.27	L.01	L.1
23 09 80 1410	0426	.020	.014		L.003	L.003	.23	L.01	L.1
07 10 80 1410	0426	.019	.012	.007	L.003	L.003	.25	L.01	L.1
22 10 80 0810	0426	.16	.14	.048	.018	.016	1.2	.94	L.1
05 11 80 0930	0426	.13	.12	.072	.056	.055	.95	.90	L.1
19 11 80 0820	0426	.12	.11	.087	.081	.078	1.1	.98	L.1
10 12 80 0900	0426	.15	.14	.13	.13	.12		1.1	.9
07 01 81 0800	0426	.13	.12	.11	.10	.10	1.1	.70	.4
28 01 81 0900	0426	.15	.15	.15	.096	.080	1.2	.90	.5
17 02 81 1600	0426	.16	.14	.13	.12	.090		.90	.5
10 03 81 1500	0426	.15	.15	.11	.11	.11	1.1	1.0	L.1
22 03 81 0830	0426	.12	.11	.08	.07	.07	1.0	.80	.2
07 04 81 1700	0426	.16	.16	.11	.11	.10	1.2	.90	.3
22 04 81 1415	0426	.13	.090	.083	.068	.065	.72	.46	L.1
05 05 81 1345	0426	.14	.089	.062	.050	.045	.20	.01	L.1
20 05 81 1445	0426	.13	.13	.026	.022	.019	.80	.44	.2
15 06 81 1630	0426	.15	.13	.033	.024	.019	.57	.46	L.1
08 07 81 0710	0426	.017	.011	.003	L.003	L.003	.13	L.01	L.1
27 07 81 1530	0426	.057	.049	.019	.014	.009	.42	.30	L.1
02 09 81 0725	0426	.025	.024	.013	.009	L.003	.22	.05	L.1
08 09 81 1530	0426	.021	.012	.010	L.003	L.003	.19	L.01	L.1
20 10 81 1100	0426	.035	.023	.009	.003	L.003	.23	L.01	L.1
20 10 81 1105	0426	.037	.023	.008	L.003	L.003	.23	.01	L.1
30 11 81 1400	0426	.10	.091	.084	.079	.079	1.6	1.5	.2

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSFHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
09 01 82 1300	0426	.19	.18	.18	.17	.17	2.1	1.7	.8
23 02 82 1100	0426	.20	.20	.17	.17	.17	1.7	1.4	.5
03 04 82 1445	0426	.24	.21	.19	.18	.16	1.5	1.0	.2

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
15 05 79 1820	0426	17.	66.	128.	112.	.27		
15 05 79 1855	0426	17.	73.	38.	31.	.13		
29 05 79 1430	0426	16.	76.	151.	140.	.46		
29 05 79 1431	0426	16.	79.	208.	191.	.43		
12 06 79 1420	0426	21.5	49.	55.	48.	.22		
12 06 79 1500	0426	21.5	43.	47.	34.			
26 06 79 1245	0426	23.	7.7	16.	9.	.18		
26 06 79 1300	0426	23.	12.	13.	6.	.96		
10 07 79 1150	0426	23.5	3.7	4.	2.	.04		
10 07 79 1215	0426	23.5	4.0	1.	L1.			
24 07 79 1225	0426	17.		3.	2.	.03		
24 07 79 1235	0426	17.		1.	1.			
06 08 79 1300	0426	24.5	1.3	2.	L1.	.10		
06 08 79 1305	0426	24.5	1.2	L1.	L1.			
21 08 79 1425	0426	24.5	1.5	1.6	1.	.07		
21 08 79 1435	0426	24.5	1.1	2.	1.			
25 09 79 0740	0426	12.	2.3	4.	2.	.09		
25 09 79 0745	0426	12.	2.6	4.	3.			
10 10 79 0655	0426	10.	4.0	12.	6.	.17		
10 10 79 0700	0426	10.	4.4	12.	9.			
30 10 79 0755	0426	3.	5.0	2.	2.	.11		
30 10 79 0800	0426	3.	3.1	L1.	L1.			
19 11 79 1525	0426	2.	3.7	11.	7.	.09 02L		
19 11 79 1530	0426	2.	2.8	3.	L1.			
10 12 79 1540	0426	0.	2.1	5.	4.	.06 02L		
10 12 79 1545	0426	0.	2.8	4.	3.			

NAQUADAT DETAILED REPORT

PARTICULATES TEMP DOC

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
08 01 80 1415	0426	1.	2.5	1.	L1.	.05 02L	.26 02L	2. 06L
08 01 80 1420	0426	1.	2.5	L1.	L1.			4. 04L
29 01 80 1340	0426	0.	2.5	3.	3.	.05 02L	.26 02L	1. 06L
29 01 80 1345	0426	0.	4.6	2.	L1.			1. 04L
19 02 80 1315	0426	0.	1.8	4.	3.	.10 02L	.55 02L	2. 06L
19 02 80 1320	0426	0.	1.6	4.	3.			1.
11 03 80 1325	0426	0.	8.5	18.	15.	.09 02L	.74 02L	2. 06L
11 03 80 1330	0426	0.	6.8	15.	12.			2. 04L
25 03 80 1135	0426	0.	12.	20.	18.	.21 02L	1.0 02L	3. 06L
25 03 80 1140	0426	0.	7.6	12.	10.			2. 04L
09 04 80 1345	0426	0. 61F	72.	231.	209.	1.3 02L	9.4 02L	4. 06L
09 04 80 1350	0426	0. 61F	64.	201.	184.			4. 04L
22 04 80 1525	0426	13. 61F	3.3	168.	152.	.72	5.4	4. 06F
22 04 80 1530	0426	13. 61F	3.1	151.	138.			5.
06 05 80 1320	0426		23.0	55.	46.	.28	1.6	2. 06F
06 05 80 1325	0426		20.0	63.	57.			2.
22 05 80 1110	0426		12.	28.	26.	.18	.88	3. 06F
22 05 80 1115	0426		12.	31.	29.			3.
04 06 80 1100	0426	13. 61F	62.0	224.	206.	.29 02L	1.7 02L	3. 04L
18 06 80 0755	0426	19. 61F	44.	106.	98.	.45	4.1	2.
18 06 80 0800	0426		45.	120.	111.			4.
02 07 80 1545	0426	23. 61F	7.7	17.0	16.0	.16	.97	2.
16 07 80 0635	0426	17.2 61F		3.	2.	.04 02L	.13 02L	4. 04L
16 07 80 0820	0426		1.5	3.	2.	.05	.29	3.
30 07 80 0830	0426	19.0 61F	4.3	3.	2.	.05	.27	3.
13 08 80 0730	0426	17.0 61F	5.4	3.	2.	.58	.86	4.
26 08 80 1630	0426	20. 61F	6.0	9.	6.	.14	.59	2.
09 09 80 0830	0426	13.8 61F		5.	4.	.07 02L	.36 02L	3. 04L
09 09 80 1510	0426	22. 61F	5.8	8.	6.	.12	.40	3.
23 09 80 1410	0426	15. 61F	4.8	6.	5.	.11	.47	3.
07 10 80 1410	0426	18. 61F	4.9	6.	5.	.09	.47	
22 10 80 0810	0426	5. 61F	46.	88.	80.	.37	2.2	2.
05 11 80 0930	0426	0. 61F	12.	30.	26.	.18	1.3	2.
19 11 80 0820	0426		8.6	12.	10.	.14	.68	1.
10 12 80 0900	0426	0. 61F	2.8	1.	L1.	.05	.28	2.
07 01 81 0800	0426	0. 61F	5.5	8.	6.	.08	.32	2.
28 01 81 0900	0426		3.5	5.	3.	.05	.18	2.
17 02 81 1600	0426		6.5	13.	11.	.08	.50	3.
10 03 81 1500	0426		13.	30.	27.	.13	1.0	2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
22 03 81 0830	0426		8.0	17.	15.	.13	.98	2.
07 04 81 1700	0426	8.0 61F	20.0	37.	34.	.26	1.5	2.
22 04 81 1415	0426	13.0 61F	4.0	8.	5.	.16	.64	2.
05 05 81 1345	0426	14.0 61F	18.0	29.	24.	.18	1.4	3.
20 05 81 1445	0426	19.0 61F	70.	190.	175.	.35	3.0	4.
15 06 81 1630	0426	14.0 61F	73.	267.	254.	.30	2.4	3.
08 07 81 0710	0426	16.0 61F		80.	71.	.12	1.1	3.
27 07 81 1530	0426	20.0 61F	24.	37.	33.	.12	.75	3.
02 09 81 0725	0426	13.8 61F		11.	6.			2.
08 09 81 1530	0426	20. 61F	.7	3.	2.	.07	.32	2.
20 10 81 1100	0426	5.0 61F	4.9	4.	2.	.23	1.2	3.
20 10 81 1105	0426	5.0 61F	5.2	3.	1.	.23	1.1	3.
30 11 81 1400	0426	.0 61F	2.5	3.	2.	.05	.25	3.
09 01 82 1300	0426	.0 61F	.9	L1.	L1.	.06	.33	3.
23 02 82 1100	0426	.0 61F	2.7	5.	3.	.08		3.
03 04 82 1445	0426	3.0 61F	6.4	11.	8.	.16	.83	5.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
15 05 79 1820	0426			143.		410.		
15 05 79 1855	0426			143.		411.		
29 05 79 1430	0426	8.2		113.	.0	327.		
29 05 79 1431	0426	8.2		113.	.0	326.		
12 06 79 1420	0426	8.3		107.	.0	323.		
12 06 79 1500	0426	8.3		107.	.0	322.		
26 06 79 1245	0426	8.5		107.	9.	318.		
26 06 79 1300	0426	8.5		108.	6.	315.		
10 07 79 1150	0426	9.2		76.	38.	285.		
10 07 79 1215	0426	9.2		78.	68.	300.		
24 07 79 1225	0426	9.2		62.	32.	309.		
24 07 79 1235	0426	9.1		63.	.0	304.		

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
06 08 79 1300	0426	9.4		67.	58.	344.		
06 08 79 1305	0426	9.4		68.	106.	357.		
21 08 79 1425	0426	9.4		77.		309.		
21 08 79 1435	0426	9.4		78.		309.		
25 09 79 0740	0426	8.2		117.	.0	418.		
25 09 79 0745	0426	8.2		117.	.0	421.		
10 10 79 0655	0426	8.2		130.	.0	425.		
10 10 79 0700	0426	8.2		131.	.0	458.		
30 10 79 0755	0426	8.3		136.	.0	466.		
30 10 79 0800	0426	8.4		138.		470.		
19 11 79 1525	0426	8.3		130.	.0	429.		
19 11 79 1530	0426	8.3		130.	.0	421.		
10 12 79 1540	0426	8.2		130.	.0	530.		
10 12 79 1545	0426	8.2		126.	.0	524.		
08 01 80 1415	0426	7.7	42. 53L	169.	.0	524.		2.2
08 01 80 1420	0426	8.0	42. 52L	171.	.0	529.		2.8
29 01 80 1340	0426	7.9	37. 53L	153.	.0	486.		2.7
29 01 80 1345	0426	7.8	36. 52L	155.	.0	480.		2.8
19 02 80 1315	0426	7.9	29. 53L	114.	.0	483.		2.8
19 02 80 1320	0426	8.0	30. 52L	119.	.0	483.		2.0
11 03 80 1325	0426	7.6	25. 53L	144.	.0	465.		4.4
11 03 80 1330	0426	7.6	27. 52L	143.	.0	471.		4.1
25 03 80 1135	0426	7.7	22. 53L	120.	.0	431.		2.8
25 03 80 1140	0426	7.7	23. 52L	110.	.0	419.		2.7
09 04 80 1345	0426	7.8	18. 53L	110. 01L	.0	377.	5.8	3.4
09 04 80 1350	0426	7.7	19. 52L	110. 01L	.0	375.	5.8	3.6
22 04 80 1525	0426	7.6	28. 53F	130. 01L	0.	385.	4.6	5.4
22 04 80 1530	0426	7.6	26.	130. 01L	0.	394.	4.6	5.3
06 05 80 1320	0426	8.7	23. 53F	130. 01L		328.	3.8	1.1
06 05 80 1325	0426	8.7	24.	130. 01L	.0	340.	3.7	.7
22 05 80 1110	0426	8.4	23. 53F	115. 01L	.5	385.	3.7	1.0
22 05 80 1115	0426	8.5	23.	114. 01L	.0	387.	3.8	1.2
04 06 80 1100	0426	8.0	22. 52L	114. 01L	.0	336.	2.4	4.5
18 06 80 0755	0426	7.7	23.	115. 01L	.0	327.	1.9	4.5
18 06 80 0800	0426	8.1	23.	118. 01L	.0	325.	2.0	4.5
02 07 80 1545	0426	8.8	23.	117. 01L	5.4	330.	2.7	3.2
16 07 80 0635	0426	8.4	24. 52L	108. 01L	2.5	381.	4.1	.5
16 07 80 0820	0426	8.4	22.	106. 01L	.2	381.	4.2	.4
30 07 80 0830	0426	8.7	21.	108. 01L	5.4	378.	4.5	.3

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
13 08 80 0730	0426	8.6	21.	98. 01L	.6	331.	4.0	.4
26 08 80 1630	0426	8.9	19.	92. 01L	3.0	312.	3.9	.6
09 09 80 0830	0426	8.7	19. 52L	97. 01L	2.0	355.	4.9	.3
09 09 80 1510	0426	9.1	18.	95. 01L	5.3	351.	5.0	.5
23 09 80 1410	0426	8.6	29.	126. 01L	2.0	404.	5.5	.4
07 10 80 1410	0426	8.7	25.	111. 01L	4.4	375.	4.9	.7
22 10 80 0810	0426	8.2	31.	135. 01L	.0	406.	4.8	2.1
05 11 80 0930	0426	8.4	36.	138. 01L	1.	412.	6.6	1.0
19 11 80 0820	0426	8.3		141. 01L	.0	417.	5.3	1.2
10 12 80 0900	0426	8.0	42.	180. 01L	.0	538.	8.2	2.2
07 01 81 0800	0426	8.0	28.	145. 01L	.0	424.	5.5	4.5
28 01 81 0900	0426	8.1	36.	140. 01L	.0	420.	6.1	3.7
17 02 81 1600	0426	8.0	34.	139. 01L	.0	427.	5.1	3.4
10 03 81 1500	0426	8.6	38.	128. 01L	3.9	403.	6.0	2.0
22 03 81 0830	0426	8.3	40.	128. 01L	.0	399.	5.3	1.2
07 04 81 1700	0426	8.4	34.	135. 01L	.0	418.	5.8	1.4
22 04 81 1415	0426	9.0	32.	135. 01L	2.8	401.	5.6	.2
05 05 81 1345	0426	9.2	28.	117. 01L	16.5	343.	4.7	.6
20 05 81 1445	0426	8.0	31.	128. 01L	.0	388.	3.7	4.4
15 06 81 1630	0426	8.1	26.	123. 01L	.0	344.	2.5	4.4
08 07 81 0710	0426	8.5	29.	127. 01L	.0	323.	1.4	2.5
27 07 81 1530	0426	8.4	33.	121. 01L	.2	327.	2.5	3.2
02 09 81 0725	0426	8.4	30.	121. 01L	.2	325.	4.1	.6
08 09 81 1530	0426	8.9	24.	102. 01L	1.5	299.	3.6	.2
20 10 81 1100	0426	8.4	29.	139. 01L	.2	464.	6.2	.1
20 10 81 1105	0426	8.4	29.	139. 01L	.2	464.	6.2	L.1
30 11 81 1400	0426	8.3	41.	166. 01L	.0	476.	12.	.6
09 01 82 1300	0426	7.7	46.	210. 01L	.0	542.	9.0	3.8
23 02 82 1100	0426	7.7	36.	145. 01L	.0	418.	6.6	3.9
03 04 82 1445	0426	7.6	32.	130. 01L	.0	413.	11.	4.0

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2080 LAT. 50D 2M 36S LONG. 110D 43M 20S PR 0 UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 05 79 1245	0426		.26	.023 13F	L.003 46F	L.003 66F	.23	.07 19F	L.1
22 05 79 1300	0426		.20	.016	.005	L.003	.27 51F	.07	L.1
04 06 79 1155	0426	.18	.15			.005 66F	.30	.17 19F	L.1
04 06 79 1200	0426	.18	.16	.023	.007	.008	.29 51F	.16	L.1
18 06 79 1115	0426	.11	.082	.022 13F	.010 46F	L.003 66F	.22	.09 19F	L.1
18 06 79 1130	0426	.10	.082	.025	.008	L.003	.19 51F	.07	L.1
04 07 79 1135	0426	.047	.031	.011 13F	L.003 46F	L.003 66F			L.1
04 07 79 1145	0426	.048	.030	.014	L.003	L.003	.20 51F	.03	L.1
17 07 79 1530	0426	.024	.007	.010 13F	L.003 46F	L.003 66F	.31	.12 19F	L.1
17 07 79 1545	0426	.026	.010	.010	L.003	L.003	.21 51F	.02	L.1
31 07 79 0620	0426	.020	.010	.011 13F	.006 46F	L.003 66F	.42	.08 19F	L.1
31 07 79 0630	0426	.019	.010	.008	.004	L.003	.25 51F	.18	L.1
18 09 79 0610	0426	.022	.008	.022 13F	.004 46F	L.003 66F	.28	L.01 19F	L.1
18 09 79 0615	0426	.027	.009	.008	L.003	L.003	.30 51F	.01	L.1
01 10 79 1655	0426	.015	.009	.007 13F	L.003 46F	L.003 66F	.20	L.01 19F	L.1
01 10 79 1700	0426	.016	.009	.006	L.003	L.003	.21 51F	L.01	L.1
17 10 79 1355	0426	.016	.012	.008 13F	.007 46F	.003 66F	.24	L.01 19F	L.1
17 10 79 1400	0426	.018	.009	.008	.004	.003	.28 51F	.02	L.1
06 11 79 0755	0426	.029	.019	.008 13L	.008 46L	.004 66L	1.6 61L	.90 19L	L.1
06 11 79 0800	0426	.024	.021	.008 03L	.006 56L	.004 56L	1.7 51L	.90 10L	L.1
26 11 79 1355	0426	.072	.058	.055 13L	.049 46L	.044 66L	1.3 61L	1.1 19L	L.1
26 11 79 1400	0426	.067	.058	.052 03L	.046 56L	.044 56L	1.2 51L	1.1 10L	L.1
17 12 79 1255	0426	.11	.096	.11 13L	.093 46L	.092 66L	2.5 61L	1.6 19L	.9
17 12 79 1300	0426	.11	.11	.11 03L	.092 56L	.092 56L	2.6 51L	1.6 10L	.9
14 01 80 1355	0426	.12	.11	.12 13L	.10 46L	.10 66L	1.8 61L	1.6 19L	.4
14 01 80 1400	0426	.12	.11	.11 03L	.10 56L	.10 56L	1.6 51L	1.5 10L	.4
04 02 80 1430	0426	.11	.10			.084 66L	1.5 61L	1.4 19L	.1
04 02 80 1435	0426	.12	.10			.084 56L	1.6 51L	1.4 10L	.1
25 02 80 1440	0426	.17	.17	.16 13L	.16 46L	.15 66L	1.8 61L	1.4 19L	.4
25 02 80 1445	0426	.17	.17	.16 03L	.16 56L	.16 56L	1.8 51L	1.4 10L	.3
17 03 80 1555	0426	.17	.16	.14 13L	.13 46L	.12 66L	1.2 61L	1.1 19L	.2
17 03 80 1600	0426	.17	.16	.14 03L	.13 56L	.13 56L	1.4 51L		.2
31 03 80 1530	0426	.12	.11	.095 13L	.085 46L	.073 66L	.99 61L	.72 19L	.1
31 03 80 1535	0426	.12	.10	.085 03L	.072 56L	.068 56L	1.0 51L	.68 10L	.1
14 04 80 1330	0426	.21	.17	.083 13L	.069 46L	.069 66L	1.2 61L	.56 19L	.5
14 04 80 1335	0426	.23	.18	.077 03L	.069 56L	.053 56L	1.2 51L	.53 10L	.5
28 04 80 1810	0426	.21	.16	.057 13F		.041 66F	.53	.30 19F	.3
28 04 80 1815	0426	.20	.18	.057		.039	.79 51F	.37	.2
12 05 80 1820	0426	.19	.19	.048 13F	.020 46F	.008 66F	.31	.16 19F	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2080 LAT. 50D 2M 36S LONG. 110D 43M 20S PR 0 UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
12 05 80 1825	0426	.19	.16	.025	.010	.007	.26 51F	.11	L.1
26 05 80 1855	0426	.90	.85	.022 13F	.019 46F	.011 66F	.43	.21 19F	L.1
26 05 80 1900	0426	.90	.85	.016	.016	.005	.35 51F	.18	L.1
09 06 80 1600	0426	.19	.16	.025 03L	.011 56L	L.003 56L	.54 61L	.28 10L	L.1
23 06 80 1815	0426	.14	.012	.022	.003	L.003	.40	.30	L.1
07 07 80 1900	0426	.030	.019	.005	.005	.005	.14	.01	L.1
16 07 80 0745	0426	.007	.007	.003 03L	L.003 56L	L.003 56L	.20 61L	L.01 10L	L.1
21 07 80 1730	0426	.011	.008	L.003	L.003	L.003	.23	L.01	L.1
05 08 80 1830	0426	.032	.021	.008	.005	L.003	.23	L.01	L.1
18 08 80 1630	0426	.024		.008	.003	L.003	.26	L.01	L.1
02 09 80 1630	0426	.015	.011	.007	.003	L.003	.18	L.01	L.1
09 09 80 0930	0426	.012	.007	.006 03L	L.003 56L	L.003 56L	.25 61L	L.01 10L	L.1
15 09 80 1600	0426	.015	.007	.006	L.003	L.003	.26	L.01	L.1
29 09 80 1700	0426	.053	.031	.011	L.003	L.003	.25	.01	L.1
14 10 80 1630	0426	.031	.023	.007	.003	L.003	.20	L.01	L.1
29 10 80 1700	0426	.072	.065	.045	.037	.035	.72	.64	L.1
10 11 80 1300	0426	.073	.059	.032	.021	.021	.54	.46	L.1
24 11 80 1600	0426	.072	.061	.051	.035	.025	.83	.72	L.1
16 12 80 0830	0426	.079	.075	.068	.056	.044	1.2	.85	.4
16 12 80 0835	0426	.076	.069	.062	.056	.047	1.2		.4
12 01 81 1500	0426	.081	.070	.068	.068	.040	.79	.49	.3
02 02 81 1600	0426	.15	.14	.11	.11	.10	1.1	.80	.3
21 02 81 1630	0426	.092	.092	.088	.072	.062	1.1	.74	.1
14 03 81 1610	0426	.43		.057	.057	.050	.82	.70	L.1
01 04 81 1730	0426	.13	.11	.068	.058	.043	.78	.64	L.1
13 04 81 1830	0426	.12	.092	.066	.058	.048	.59	.35	L.1
27 04 81 1720	0426	.13	.085	.070	.047	.022	.26	L.01	L.1
11 05 81 1630	0426	.15	.15	.016	.010	.005	.30	.14	.1
25 05 81 1800	0426	.23	.22	.011	L.003	L.003	.43	.21	L.1
08 07 81 0840	0426	.021	.021	.004	L.003	L.003	.13	L.01	L.1
12 07 81 1630	0426	.023	.015	.004	L.003	L.003	.12	L.01	L.1
17 08 81 1630	0426	.023	.011	.006	.004	L.003	.14	L.01	.1
02 09 81 0840	0426	.015	.012	.010	.003	L.003	.19	L.01	L.1
28 09 81 1715	0426	.030	.013	.010	.004	L.003	.29	L.01	L.1
10 11 81 1400	0426	.079	.062	.037	.024	.023	1.1	.78	L.1
15 12 81 0900	0426	.10	.082	.084	.080	.073	1.6	1.0	.4
15 12 81 0905	0426	.084	.080	.080	.080	.076	1.5	1.0	.5
08 02 82 1700	0426	.24	.21	.21	.18	.18	2.1	1.6	
22 03 82 1430	0426	.19	.17	.16	.16	.16	1.5	1.4	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2080 LAT. 50D 2M 36S LONG. 110D 43M 20S PR 0 UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
26 04 82 1530	0426	.21	.17	.060	.054	.052	.88	.70	.3

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
22 05 79 1245	0426	16.	170.	912.	852.	.93		
22 05 79 1300	0426	16.	170.	918.	836.	.89		
04 06 79 1155	0426	18.	84.	127.	112.	.39		
04 06 79 1200	0426	18.	86.	130.	117.	.85		
18 06 79 1115	0426	17.5	51.	54.	52.	.20		
18 06 79 1130	0426	17.5	51.	62.	61.	.20		
04 07 79 1135	0426	19.5		21.	17.	1.3		
04 07 79 1145	0426	19.5		25.	20.			
17 07 79 1530	0426	24.5	5.7	6.	4.	.02		
17 07 79 1545	0426	24.5	4.2	3.	2.			
31 07 79 0620	0426	20.5	3.4	2.0	L1.0	.04		
31 07 79 0630	0426	20.5	3.2	L1.0	L1.0			
18 09 79 0610	0426	16.	2.1	1.	L1.	.08		
18 09 79 0615	0426		2.3	2.	L1.			
01 10 79 1655	0426	12.	3.1	4.	3.			
01 10 79 1700	0426	12.	2.9	6.	4.			
17 10 79 1355	0426	12.	3.2	9.	4.	.08		
17 10 79 1400	0426	12.	3.3	L1.				
06 11 79 0755	0426	5.	3.9	8.	7.	.14 02L		
06 11 79 0800	0426	5.	4.0	8.	7.			
26 11 79 1355	0426	0.	1.4	L1.	L1.	.07 02L		
26 11 79 1400	0426	0.	1.6	L1.	L1.			
17 12 79 1255	0426	8.	1.2	2.	1.	.03 02L		
17 12 79 1300	0426	8.	1.2	5.	4.			
14 01 80 1355	0426	0.	1.0	L1.	L1.	.03 02L	.15 02L	2. 06L
14 01 80 1400	0426	0.	.8	L1.	L1.			2. 04L
04 02 80 1430	0426	0.	1.6	L1.	L1.	.04 02L	.18 02L	2. 06L

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2080 LAT. 50D 2M 36S LONG. 110D 43M 20S PR 0 UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE MEDICINE HAT

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
04	02	80	1435	0426	0.	1.4	2.	L1.			2. 04L
25	02	80	1440	0426	10.	1.4	3.	L1.	.03 02L	.21 02L	2. 06L
25	02	80	1445	0426	10.	2.1	3.	2.			1. 04L
17	03	80	1555	0426	18.	3.8	5.	3.	.07 02L	.36 02L	3. 06L
17	03	80	1600	0426	18.	4.4	4.	1.			3. 04L
31	03	80	1530	0426	0. 61F	6.0	8.	8.	.10 02L	.54 02L	5. 06L
31	03	80	1535	0426	0. 61F	6.1	8.	8.			4. 04L
14	04	80	1330	0426	3. 61F	5.7	66.	59.	.43 02L	3.3 02L	4. 06L
14	04	80	1335	0426	3. 61F	4.6	84.	55.			4. 04L
28	04	80	1810	0426	17. 61F	6.2	52.	44.	.48	3.2	3. 06F
28	04	80	1815	0426	17. 61F	20.0	73.	63.			3.
12	05	80	1820	0426	15. 61F	61.0	183.		.72	4.3	2. 06F
12	05	80	1825	0426	15. 61F	72.0	202.	187.			2.
26	05	80	1855	0426	14. 61F	530.	1191.	1118.	1.3	12.2	2. 06F
26	05	80	1900	0426	14. 61F	510.	1119.	1045.			3.
09	06	80	1600	0426	13. 61F	74.0	168.	152.	.36 02L	2.4 02L	3. 04L
23	06	80	1815	0426	19. 61F	38.	89.0	74.0	.23	2.2	2.
07	07	80	1900	0426		5.4	11.0	10.0	.11	.98	2.
16	07	80	0745	0426	18.8 61F		6.	5.	.05 02L	.25 02L	3. 04L
21	07	80	1730	0426	24.0 61F	5.3	5.	3.	.08	.35	3.
05	08	80	1830	0426	18.0 61F	20.	30.	27.	.12	.95	4.
18	08	80	1630	0426	17.0 61F	4.5	9.	7.	.11	.68	3.
02	09	80	1630	0426	20. 61F	5.6	9.	6.	.07	.42	3.
09	09	80	0930	0426	16.3 61F		5.	4.	.06 02L	.32 02L	3. 04L
15	09	80	1600	0426	13. 61F	5.3	6.	6.	.05	.37	3.
29	09	80	1700	0426	15.5 61F	17.	38.	33.	.16	.96	3.
14	10	80	1630	0426	9. 61F	13.	20.	16.	.16	1.2	3.
29	10	80	1700	0426	5. 61F	14.	21.	17.	.08	.40	2.
10	11	80	1300	0426	7. 61F	9.2	19.	16.	.14	.79	2.
24	11	80	1600	0426	.0 61F	6.0	13.	11.	.09	.52	2.
16	12	80	0830	0426		3.0	5.	4.	.08	.22	2.
16	12	80	0835	0426		2.7	5.	5.	.07	.21	2.
12	01	81	1500	0426	0. 61F	3.3	4.	3.	.02	.16	2.
02	02	81	1600	0426		15.	23.	21.	.15	.71	2.
21	02	81	1630	0426		4.2	3.	2.	.07	.23	2.
14	03	81	1610	0426		190.	313.	285.	1.6	10.4	2.
01	04	81	1730	0426	8.0 61F	14.0	31.	26.	.22	1.4	2.
13	04	81	1830	0426	6.0 61F	8.4	15.	13.	.18	.70	2.
27	04	81	1720	0426	14.0 61F	4.3	11.	8.	.31	1.7	3.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2080 LAT. 50D 2M 36S LONG. 110D 43M 20S PR 0 UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
11 05 81 1630	0426	12.0 61F	140.	334.	308.	.26	1.9	0.
25 05 81 1800	0426	14.0 61F	330.	1354.	1320.	.38	3.2	5.
08 07 81 0840	0426	17.5 61F		155.	141.	.16	1.1	3.
12 07 81 1630	0426	21.0 61F	22.	35.	31.	.14	.80	2.
17 08 81 1630	0426	24. 61F	5.8	15.	13.	.14	.88	2.
02 09 81 0840	0426	15. 61F		2.	L1.			3.
28 09 81 1715	0426	11. 61F	4.5	7.	5.	.20	1.1	3.
10 11 81 1400	0426		16.0	23.	20.	.20	1.3	3.
15 12 81 0900	0426	.0 61F	1.8	1.0	L1.	.03	.19	3.
15 12 81 0905	0426	.0 61F	2.5	1.0	L1.	.04	.21	3.
08 02 82 1700	0426	.0 61F	2.8	4.	3.	.06	.42	2.
22 03 82 1430	0426	4. 61F	8.6	12.	10.	.13	.84	3.
26 04 82 1530	0426	10.0 61F	33.	79.	72.	.43	3.2	4.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
22 05 79 1245	0426	8.2		113.	.0	320.		
22 05 79 1300	0426	8.2		113.	.0	318.		
04 06 79 1155	0426	8.1		112.	.0	309.		
04 06 79 1200	0426	8.1		112.	.0	309.		
18 06 79 1115	0426	8.2		116.	.0	303.		
18 06 79 1130	0426	8.2		117.	.0	304.		
04 07 79 1135	0426	8.5		112.	20.	372.		
04 07 79 1145	0426	8.5		113.	9.	372.		
17 07 79 1530	0426	8.7		88.		333.		
17 07 79 1545	0426	8.7		88.		337.		
31 07 79 0620	0426	8.7		96.	.0	377.		
31 07 79 0630	0426	8.7		93.	17.	398.		
18 09 79 0610	0426	8.3		114.	.0	437.		
18 09 79 0615	0426	8.5		114.	.2	439.		
01 10 79 1655	0426	8.3		117.	.0	472.		
01 10 79 1700	0426	8.3		118.	.0	470.		

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2080   LAT. 50D 2M 36S LONG. 110D 43M 20S   PR 0   UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE   MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
17 10 79 1355	0426	8.3		114.	.0	460.		
17 10 79 1400	0426	8.3		120.	.0	473.		
06 11 79 0755	0426	8.3		136.	.0	488.		
06 11 79 0800	0426	8.3		136.	.0	479.		
26 11 79 1355	0426	8.2		134.	.0	503.		
26 11 79 1400	0426	8.2		137.	.0	507.		
17 12 79 1255	0426	8.1		169.	.0	594.		
17 12 79 1300	0426	8.0		171.	.0	594.		
14 01 80 1355	0426	7.9	41. 53L	169.	.0	535.		2.0
14 01 80 1400	0426	7.9	35. 52L	172.	0.	531.		2.0
04 02 80 1430	0426	7.8	38. 53L	165.	.0	542.		.6
04 02 80 1435	0426	7.9	37. 52L	170.	.0	543.		.6
25 02 80 1440	0426	7.8	30. 53L	167.	.0	510.		2.8
25 02 80 1445	0426	7.8	32. 52L	168.	.0	511.		2.6
17 03 80 1555	0426	7.7	28. 53L	130.	.0	496.		2.8
17 03 80 1600	0426	7.8	29. 52L	127.	.0	490.		2.8
31 03 80 1530	0426	8.5	17. 53L	110. 01L	4.0	310.	8.	1.2
31 03 80 1535	0426	8.4	17. 52L	110. 01L	5.9	308.	8.1	.5
14 04 80 1330	0426	8.2	21. 53L	120. 01L	.0	408.	4.8	3.2
14 04 80 1335	0426	8.0	25. 52L	120. 01L	.0	405.	4.9	3.2
28 04 80 1810	0426	8.2	25. 53F	140. 01L	0.	408.	5.7	3.3
28 04 80 1815	0426	8.1	25.	130. 01L	0.	405.	3.9	3.1
12 05 80 1820	0426	8.3	23. 53F	125. 01L	0.	319.	2.4	2.6
12 05 80 1825	0426	8.4	24.	127. 01L	.0	318.	2.5	1.8
26 05 80 1855	0426	8.0	23. 53F	112. 01L	0.	346.	3.7	3.5
26 05 80 1900	0426	8.0	23.	105. 01L	0.	341.	3.7	3.5
09 06 80 1600	0426	8.0	23. 52L	115. 01L	.0	314.	1.7	4.6
23 06 80 1815	0426	8.3	22.	111. 01L	.0	299.	1.7	3.5
07 07 80 1900	0426	8.8	23.	109. 01L	4.7	335.	3.1	.6
16 07 80 0745	0426	8.3	24. 52L	112. 01L	.0	381.	4.1	.8
21 07 80 1730	0426	8.9	22.	108. 01L	7.4	387.	4.1	.5
05 08 80 1830	0426	8.8	22.	107. 01L	5.1	386.	5.1	L.1
18 08 80 1630	0426	8.7	20.	101. 01L	.1	351.	5.0	.4
02 09 80 1630	0426	8.8	21.	101. 01L	3.0	369.	5.2	.6
09 09 80 0930	0426	8.7	22. 52L	106. 01L	2.6	396.	5.7	.4
15 09 80 1600	0426	8.7	25.	111. 01L	3.9	405.	6.0	.4
29 09 80 1700	0426	8.4	30.	126. 01L	.0	410.	4.8	.7
14 10 80 1630	0426	8.5	28.	125. 01L	4.0	389.	4.7	.6
29 10 80 1700	0426	8.5		140. 01L	1.4	415.	5.3	2.7

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2080 LAT. 50D 2M 36S LONG. 110D 43M 20S PR 0 UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
10 11 80 1300	0426	8.6	36.	135. 01L	2.1	378.	3.9	.5
24 11 80 1600	0426	8.4	34.	142. 01L	.0	420.	5.1	1.0
16 12 80 0830	0426	8.0	38.	165. 01L	.0	506.	7.9	1.9
16 12 80 0835	0426	8.2	37.	162. 01L	.0	505.	7.8	2.0
12 01 81 1500	0426	8.1		140. 01L	.0	396.	3.8	4.1
02 02 81 1600	0426	7.9	37.	142. 01L	.0	423.	5.2	3.4
21 02 81 1630	0426	8.0	30.	126. 01L	.0	395.	5.4	2.6
14 03 81 1610	0426	8.2	38.	127. 01L	.0	398.	5.4	2.7
01 04 81 1730	0426	8.5	43.	145. 01L	.0	467.	7.0	.7
13 04 81 1830	0426	8.7	33.	145. 01L	7.0	445.	5.0	.1
27 04 81 1720	0426	9.0	30.	132. 01L	14.0	392.	4.7	.4
11 05 81 1630	0426	8.3	27.	117. 01L	.0	342.	3.7	3.4
25 05 81 1800	0426	8.0	28.	118. 01L	.0	319.	1.3	5.7
08 07 81 0840	0426	8.5	29.	122. 01L	.0	318.	2.0	1.4
12 07 81 1630	0426	8.8	29.	124. 01L	6.0	316.	2.4	1.2
17 08 81 1630	0426	8.8	26.	113. 01L	2.0	311.	3.1	1.3
02 09 81 0840	0426	8.5	30.	120. 01L	.3	340.	4.1	.6
28 09 81 1715	0426	8.4	21.	122. 01L	.2	398.	5.3	.6
10 11 81 1400	0426	8.2	25.	146. 01L	.0	417.	5.2	.4
15 12 81 0900	0426	8.2	42.	185. 01L	.0	521.	8.7	1.0
15 12 81 0905	0426	8.2	44.	185. 01L	.0	529.	8.7	.9
08 02 82 1700	0426	7.5	47.	180. 01L	.0	478.	8.7	4.4
22 03 82 1430	0426	7.7	36.	140. 01L	.0	420.	12.	3.2
26 04 82 1530	0426	8.1	26.	120. 01L	.0	353.	5.9	3.3

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2085 LAT. 50D 3M 43S LONG. 110D 39M 13S PR 3 UTM 12 524800E 5545350N
SOUTH SASKATCHEWAN RIVER - BELOW MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 05 79 1010	0426	.35	.22	.018 13F	.007 46F	L.003 66F	.25	.08 19F	L.1
22 05 79 1050	0426	.34	.20	.019	.008	.006	.27 51F	.08	L.1
04 06 79 1330	0426	.18	.160	.024 13F	.010 46F	.006 66F	.31	.17 19F	L.1
04 06 79 1400	0426	.18	.16	.024	.008	.009	.38 51F	.21	L.1
18 06 79 1310	0426	.086	.077	.021 13F	.017 46F	.008 66F	.19	.06 19F	L.1
18 06 79 1330	0426	.084	.077	.024	.009	.011	.16 51F	.06	L.1
04 07 79 1345	0426		.034	.014 13F	L.003 46F	L.003 66F	.36	.02 19F	L.1
04 07 79 1400	0426		.037	.013	L.003	L.003	.24 51F	.01	L.1
17 07 79 0955	0426	.023	.010	.009 13F	L.003 46F	L.003 66F	.21	.01 19F	L.1
17 07 79 1015	0426	.033	.011	.007	L.003	L.003	.23 51F	.01	L.1
31 07 79 0820	0426	.026	.015	.014 13F	.005 46F	L.003 66F	.26	.03 19F	L.1
31 07 79 0835	0426	.023	.017	.017	.004	L.003	.32 51F	.14	L.1
17 09 79 0525	0426	.025	.011	.015 13F	.005 46F	L.003 66F	.34	.02 19F	L.1
17 09 79 0530	0426	.021	.015	.012	.004	L.003	.30 51F	.02	L.1
01 10 79 1520	0426	.048	.033	.048 13F	.023 46F	.023 66F	.37	.07 19F	.2
01 10 79 1525	0426	.053	.033	.031	.021	.021	.39 51F	.07	.2
17 10 79 1215	0426	.035	.024	.015 13F	.012 46F	L.003 66F	.25	L.01 19F	L.1
17 10 79 1220	0426	.035	.021	.011	.008	.003	.38 51F	.03	L.1
05 11 79 1555	0426	.041	.030	.014 13L	.012 46L	.007 66L	1.7 61L	.90 19L	L.1
05 11 79 1600	0426	.040	.031	.013 03L	.007 56L	.007 56L	1.7 51L	.85 10L	L.1
26 11 79 1255	0426	.075	.060	.071 13L	.055 46L	.048 66L	1.4 61L	1.1 19L	.1
26 11 79 1300	0426	.075	.060	.060 03L	.052 56L	.047 56L	1.3 51L	1.1 10L	L.1
17 12 79 1210	0426	.13	.12	.13 13L	.11 46L	.10 66L	2.9 61L	1.6 19L	1.0
17 12 79 1215	0426	.13	.12	.13 03L	.12 56L	.10 56L	2.7 51L	1.5 10L	1.0
14 01 80 1225	0426	.13	.12	.13 13L	.11 46L	.11 66L	1.8 61L	1.6 19L	.4
14 01 80 1230	0426	.13	.12	.12 03L	.11 56L	.11 56L	2.0 51L	1.5 10L	.4
04 02 80 1355	0426	.13	.12			.10 66L	1.6 61L	1.3 19L	.2
04 02 80 1400	0426	.18	.13			.11 56L	1.6 51L	1.4 10L	.2
25 02 80 1410	0426	.18	.18	.16 13L	.16 46L	.15 66L	1.9 61L	1.4 19L	.5
25 02 80 1415	0426	.18	.18	.16 03L	.16 56L	.16 56L	1.8 51L	1.4 10L	.5
17 03 80 1515	0426	.20	.18	.14 13L	.14 46L	.14 66L	1.4 61L	1.1 19L	.3
17 03 80 1520	0426	.20	.18	.14 03L	.14 56L	.13 56L	1.5 51L	.80 10L	.3

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2085 LAT. 50D 3M 43S LONG. 110D 39M 13S PR 3 UTM 12 524800E 5545350N
SOUTH SASKATCHEWAN RIVER - BELOW MEDICINE HAT

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
22	05	79	1010	0426	14.5	150.	470.	410.	.69		
22	05	79	1050	0426	14.5	150.	446.	406.	.80		
04	06	79	1330	0426	18.	86.	186.	158.	.64		
04	06	79	1400	0426	18.	89.	149.	125.	L.01		
18	06	79	1310	0426	18.	43.	42.	40.	.16		
18	06	79	1330	0426	18.	44.	61.	59.	.16		
04	07	79	1345	0426	20.5		23.	19.	.12		
04	07	79	1400	0426	20.5		24.	19.			
17	07	79	0955	0426	23.5	5.3	3.	3.	.04		
17	07	79	1015	0426	23.5	4.3	2.	L1.			
31	07	79	0820	0426	21.	2.1	1.3	L1.	.04		
31	07	79	0835	0426	21.	2.1	5.6	2.			
17	09	79	0525	0426	18.	2.7	1.	L1.	.11		
17	09	79	0530	0426		2.4	1.				
01	10	79	1520	0426	12.	2.1	3.	L1.	.10		
01	10	79	1525	0426	12.	2.4	3.	1.			
17	10	79	1215	0426	11.	4.4	8.	8.	.12		
17	10	79	1220	0426	11.	4.4	7.	5.			
05	11	79	1555	0426	1.	4.3	9.	7.	.14 02L		
05	11	79	1600	0426	1.	3.8	9.	7.			
26	11	79	1255	0426	0.	2.3	L1.	L1.	.07 02L		
26	11	79	1300	0426	0.	3.1	L1.	L1.			
17	12	79	1210	0426	1.	.7	1.	L1.	.07 02L		
17	12	79	1215	0426	1.	.8	3.	2.			
14	01	80	1225	0426	0.	1.2	1.	1.	.04 02L	.24 02L	2. 06L
14	01	80	1230	0426	0.	.8	L1.	L1.			2. 04L
04	02	80	1355	0426	0.	2.6	8.	6.	.08 02L	.45 02L	2. 06L
04	02	80	1400	0426	0.	1.5	8.	6.			2. 04L
25	02	80	1410	0426	.5	3.2	9.	8.	.12 02L	.74 02L	2. 06L
25	02	80	1415	0426	.5	3.2	8.	7.			2. 04L
17	03	80	1515	0426	0.	5.4	15.	13.	.14 02L	.91 02L	3. 06L
17	03	80	1520	0426	0.	8.7	13.	8.			3. 04L

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2085 LAT. 50D 3M 43S LONG. 110D 39M 13S PR 3 UTM 12 524800E 5545350N
SOUTH SASKATCHEWAN RIVER - BELOW MEDICINE HAT

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
22	05	79	1010	0426	8.2		113.	.0	324.		
22	05	79	1050	0426	8.2		113.	.0	324.		
04	06	79	1330	0426	8.1		113.	.0	311.		
04	06	79	1400	0426	8.1		113.	.0	316.		
18	06	79	1310	0426	8.2		117.	.0	307.		
18	06	79	1330	0426	8.3		117.	.0	306.		
04	07	79	1345	0426	8.5		113.	23.	372.		
04	07	79	1400	0426	8.3		113.	.0	377.		
17	07	79	0955	0426	8.7		89.		347.		
17	07	79	1015	0426	8.7		91.		342.		
31	07	79	0820	0426	8.7		98.	9.	378.		
31	07	79	0835	0426	8.7		96.		404.		
17	09	79	0525	0426	8.9		114.	2.1	446.		
17	09	79	0530	0426	8.8		114.	1.1	446.		
01	10	79	1520	0426	8.5		117.	3.4	490.		
01	10	79	1525	0426	8.5		120.	2.9	490.		
17	10	79	1215	0426	8.4		122.	.8	486.		
17	10	79	1220	0426	8.3		124.	.0	495.		
05	11	79	1555	0426	8.3		136.	.0	485.		
05	11	79	1600	0426	8.3		135.	.0	480.		
26	11	79	1255	0426	8.2		134.	.0	517.		
26	11	79	1300	0426	8.2		138.	.0	457.		
17	12	79	1210	0426	8.0		174.	.0	594.		
17	12	79	1215	0426	8.0		175.	.0	600.		
14	01	80	1225	0426	7.9	41. 53L	166.	.0	534.		1.9
14	01	80	1230	0426	8.0	36. 52L	166.	.0	533.		1.9
04	02	80	1355	0426	7.9	38. 53L	174.	.0	543.		.6
04	02	80	1400	0426	7.9	37. 52L	173.	.0	543.		.7
25	02	80	1410	0426	7.7	32. 53L	167.	.0	517.		2.9
25	02	80	1415	0426	7.7	32. 52L	167.	.0	510.		3.8
17	03	80	1515	0426	7.9	28. 53L	126.	.0	492.		2.8
17	03	80	1520	0426	8.0	29. 52L	127.	.0	489.		2.7

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2087 LAT. 50D 8M 30S LONG. 110D 39M 28S PR 3 UTM 12 524450E 5554200N
SOUTH SASKATCHEWAN RIVER BELOW MEDICINE HAT

SAMPLE DATE MST D	M	Y	HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
31	03	80	1415	0426	.16	.14	.099 13L	.084 46L	.077 66L	1.1 61L	.68 19L	.2
31	03	80	1420	0426	.17	.15	.093 03L	.087 56L	.079 56L	1.0 51L	.68 10L	.2
14	04	80	1440	0426	.25	.20	.10 13L	.081 46L	.066 66L	1.3 61L	.60 19L	.6
14	04	80	1445	0426	.26	.20	.12 03L	.072 56L	.064 56L	1.3 51L	.68 10L	.6
28	04	80	1325	0426	.25	.19	.064 13F	.054 46F	.049 66F	.70	.43 19F	.2
28	04	80	1330	0426		.19	.063		.040	.95 51F	.48	.2
12	05	80	1605	0426	.23	.21	.043 13F	.028 46F	.022 66F	.32	.15 19F	.1
12	05	80	1610	0426	.25	.21	.022	.009	L.003	.55 51F	.17	L.1
26	05	80	1625	0426	.54	.44	.021 13F	.015 46F	.006 66F	.42	.15 19F	L.1
26	05	80	1630	0426		.44	.015	.011	L.003	.38 51F	.14	L.1
09	06	80	1545	0426	.24	.24	.027 03L	.011 56L	L.003 56L	.45 61L	.27 10L	L.1
23	06	80	1600	0426	.094		.022		.008	.39	.30	L.1
07	07	80	1500	0426	.042	.025	.005		.005	.16	L.01	L.1
21	07	80	1600	0426	.018	.011	.004	L.003	L.003	.25	.02	L.1
05	08	80	1545	0426	.080	.063	.007	.004	L.003	.29	.05	L.1
18	08	80	1445	0426	.034	.022	.009	.005	L.003	.23	.01	L.1
02	09	80	1435	0426	.021	.021	.006	.003	L.003	.21	.03	L.1
02	09	80	1440	0426	.020	.010	.005	L.003	L.003	.20	.03	L.1
15	09	80	1515	0426	.030	.014	.016	.007	L.003		.04	L.1
29	09	80	1500	0426	.060	.036	.009	L.003	L.003	.26	.02	L.1
14	10	80	1500	0426	.026	.015	.007	L.003	L.003	.20	L.01	L.1
29	10	80	1510	0426	.046	.039	.029	.019	.019	.68	.55	L.1
10	11	80	1530	0426	.079	.063	.035	.025	.021	.59	.48	L.1
24	11	80	1450	0426	.083	.072	.051	.022	.021	.98	.78	.1
15	12	80	1519	0426	.11	.11	.091	.067	.055	1.5	1.0	.4
12	01	81	1410	0426	.084	.083	.070	.047	.047	.77	.50	.4
02	02	81	1500	0426	.12	.12	.12	.11	.12	1.1	.85	.3
22	02	81	0930	0426	.11	.11	.093	.084	.081	1.0	.74	.2
14	03	81	1440	0426	.095	.095	.075	.075	.064	1.0	.75	.1
01	04	81	1600	0426	.13	.11	.070	.050	.050	.82	.62	L.1
13	04	81	1700	0426	.11	.097	.063	.059	.040	.64	.37	L.1
27	04	81	1600	0426	.14	.088	.062	.043	.012	.20	L.01	L.1
11	05	81	1430	0426	.22	.19	.023	.012	.008	.65	.23	.1
25	05	81	1330	0426	.27	.25	.011	L.003	L.003	.48	.25	L.1
15	06	81	1300	0426	.098	.023		.017	.012	.42	.33	L.1
27	07	81	1745	0426	.14	.063	.035	.030	.023	.58	.45	L.1
08	09	81	1300	0426	.020	.015	.010	L.003	L.003	.18	L.01	L.1
20	10	81	0800	0426	.054	.033	.015	.007	L.003	.31	.05	L.1
01	12	81	0930	0426	.15	.14	.12	.12	.11	1.6	1.4	.5

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2087 LAT. 50D 8M 30S LONG. 110D 39M 28S PR 3 UTM 12 524450E 5554200N
SOUTH SASKATCHEWAN RIVER BELOW MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
09 01 82 1100	0426	.20	.18	.19	.18	.18	2.6	2.0	.9
22 02 82 1500	0426	.26	.24	.20	.19	.18	1.9	1.4	.7
03 04 82 1530	0426	.20	.18	.14	.13	.12	1.3	1.0	.2
03 04 82 1535	0426	.19	.17	.14	.13	.12	1.2	1.1	.2

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
31 03 80 1415	0426	0. 61F	7.4	24.	20.	.18 02L	1.1 02L	4. 06L
31 03 80 1420	0426	0. 61F	7.6	26.	22.			4. 04L
14 04 80 1440	0426	7. 61F	5.1	96.	70.	.35 02L	3.0 02L	4. 06L
14 04 80 1445	0426	7. 61F	4.3	85.	55.			4. 04L
28 04 80 1325	0426	17. 61F	6.8	93.	80.	.50	2.8	3. 06F
28 04 80 1330	0426	17. 61F	32.0	78.	67.			3.
12 05 80 1605	0426	16. 61F	92.0	243.		.78	4.8	2. 06F
12 05 80 1610	0426	16. 61F	97.5	236.	219.			2.
26 05 80 1625	0426	16. 61F	330.	694.	644.	.73	6.2	3. 06F
26 05 80 1630	0426	16. 61F	300.	675.	628.			3.
09 06 80 1545	0426	18. 61F	58.0	202.	184.	.37 02L	2.6 02L	3. 04L
23 06 80 1600	0426	20. 61F	36.	86.0	76.0	.24	1.9	2.
07 07 80 1500	0426		6.7	19.0	18.0	.16	1.1	3.
21 07 80 1600	0426	24.0 61F	7.8	11.	9.	.09	.56	3.
05 08 80 1545	0426	21.0 61F	6.8	115.	105.	.28	2.2	4.
18 08 80 1445	0426	20.0 61F	7.5	17.	15.	.11	.66	3.
02 09 80 1435	0426	19. 61F	4.7	10.	7.	.11	.53	3.
02 09 80 1440	0426	19. 61F	4.3	9.	7.	.09	.52	3.
15 09 80 1515	0426	15. 61F	3.3	4.	2.	.19	.84	5.
29 09 80 1500	0426	17. 61F	14.	42.	37.	.16	.76	3.
14 10 80 1500	0426	10. 61F	9.5	12.	9.	.13	.77	3.
29 10 80 1510	0426	8. 61F	7.0	8.	6.	.07	.38	2.
10 11 80 1530	0426	5. 61F	10.	23.	20.	.10	.70	2.
24 11 80 1450	0426		9.4	23.	20.	.24	.28	1.
15 12 80 1519	0426		5.5	11.	10.	.11	.41	2.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2087 LAT. 50D 8M 30S LONG. 110D 39M 28S PR 3 UTM 12 524450E 5554200N
SOUTH SASKATCHEWAN RIVER BELOW MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
12 01 81 1410	0426	0. 61F	4.5	6.	5.	.03	.19	2.
02 02 81 1500	0426		3.0	4.	3.	.04	.12	2.
22 02 81 0930	0426		6.3	9.	7.	.11	.27	2.
14 03 81 1440	0426		9.6	37.	32.	.14	.64	2.
01 04 81 1600	0426	7.0 61F	14.0	33.	29.	.21	1.1	3.
13 04 81 1700	0426	6.0 61F	14.0	26.	23.	.23	1.1	2.
27 04 81 1600	0426	13.0 61F	5.0	14.	10.	.36	2.1	3.
11 05 81 1430	0426	12.0 61F	130.	105.	93.	.44	3.7	3.
25 05 81 1330	0426	17.0 61F	320.	2240.	2180.	.50	4.9	5.
15 06 81 1300	0426	14.0 61F	50.	132.	122.	.21	1.6	3.
27 07 81 1745	0426	20.0 61F	16.	17.	15.	.13	.70	3.
08 09 81 1300	0426	19. 61F	2.2	5.	3.	.10	.64	3.
20 10 81 0800	0426	6.0 61F	5.7	8.	6.	.32	1.6	4.
01 12 81 0930	0426	.0 61F	5.5	10.	8.	.09	.47	3.
09 01 82 1100	0426	.0 61F	.8	L1.	L1.	.04	.21	3.
22 02 82 1500	0426	.0 61F	24.	41.	35.	.20		4.
03 04 82 1530	0426		13.	18.	16.	.19	1.0	5.
03 04 82 1535	0426		13.	21.	18.	.17	.91	5.

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
31 03 80 1415	0426	8.4	18. 53L	110. 01L	8.7	329.	8.6	1.6
31 03 80 1420	0426	8.4	19. 52L	110. 01L	.0	323.	8.5	1.6
14 04 80 1440	0426	8.0	25. 53L	120. 01L	.0	452.	5.1	3.8
14 04 80 1445	0426	8.0	26. 52L	120. 01L	.0	434.	5.1	3.6
28 04 80 1325	0426	7.9	25. 53F	140. 01L	0.	412.	4.3	3.5
28 04 80 1330	0426	8.1	25.	140. 01L	0.	409.	4.2	3.6
12 05 80 1605	0426	8.2	24. 53F	126. 01L	0.	327.	2.3	2.6
12 05 80 1610	0426	8.2	24.	122. 01L	0.	324.	2.4	2.3
26 05 80 1625	0426	8.0		106. 01L	0.	367.	3.5	3.0
26 05 80 1630	0426	8.0	24.	117. 01L	0.	359.	3.5	3.1
09 06 80 1545	0426	8.0	23. 52L	116. 01L	.0	316.	1.7	4.1

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2087 LAT. 50D 8M 30S LONG. 110D 39M 28S PR 3 UTM 12 524450E 5554200N
SOUTH SASKATCHEWAN RIVER BELOW MEDICINE HAT

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
23 06 80 1600	0426	8.3	22.	111. 01L	.0	301.	1.8	3.5
07 07 80 1500	0426	8.7	22.	109. 01L	3.9	343.	3.0	.6
21 07 80 1600	0426	8.8	21.	103. 01L	4.9	398.	4.9	.4
05 08 80 1545	0426	8.4	22.	106. 01L	.2	411.	5.5	.6
18 08 80 1445	0426	8.7	21.	105. 01L	.0	365.	5.1	.4
02 09 80 1435	0426	8.8	21.	108. 01L	6.0	395.	6.0	.8
02 09 80 1440	0426	8.8	22.	108. 01L	5.0	395.	5.8	.4
15 09 80 1515	0426	8.7	26.	112. 01L	4.2	431.	6.9	.2
29 09 80 1500	0426	8.6	29.	128. 01L	2.7	424.	4.9	.4
14 10 80 1500	0426	8.7	27.	120. 01L	6.0	382.	4.7	.2
29 10 80 1510	0426	8.8		136. 01L	5.0	426.	5.8	.9
10 11 80 1530	0426	8.5	37.	134. 01L	2.0	385.	4.1	.7
24 11 80 1450	0426	8.3	35.	142. 01L	.0	431.	5.8	1.4
15 12 80 1519	0426	8.1	43.	174. 01L	.0	548.	7.6	1.7
12 01 81 1410	0426	8.1		140. 01L	.0	406.	4.0	4.2
02 02 81 1500	0426	8.0	34.	143. 01L	.0	435.	5.5	3.4
22 02 81 0930	0426	8.0	30.	125. 01L	.0	407.	5.4	2.6
14 03 81 1440	0426	8.2	33.	128. 01L	.0	418.	5.7	1.1
01 04 81 1600	0426	8.5	43.	142. 01L	.0	482.	6.4	.6
13 04 81 1700	0426	8.7	33.	147. 01L	8.0	454.	5.1	.2
27 04 81 1600	0426	9.0	27.	129. 01L	14.0	396.	5.0	.2
11 05 81 1430	0426	8.3	28.	118. 01L	.0	349.	3.1	3.3
25 05 81 1330	0426	7.9	28.	117. 01L	.0	329.	1.3	5.6
15 06 81 1300	0426	8.2	26.	121. 01L	.0	330.	2.0	4.2
27 07 81 1745	0426	8.6	32.	124. 01L	.2	338.	2.9	2.2
08 09 81 1300	0426	8.8	27.	111. 01L	2.	342.	3.6	L.1
20 10 81 0800	0426	8.2	30.	147. 01L	.0	515.	7.4	L.1
01 12 81 0930	0426	8.3	42.	173. 01L	.0	546.	21.	.8
09 01 82 1100	0426	7.8	49.	219. 01L	.0	589.	11.	2.8
22 02 82 1500	0426	7.7	35.	140. 01L	.0	413.	6.8	3.8
03 04 82 1530	0426	7.9	32.	130. 01L	.0	447.	13.	2.8
03 04 82 1535	0426	7.9	32.	130. 01L	.0	436.	13.	2.0

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2090 LAT. 50D 38M 0S LONG. 110D 12M 0S PR 3 UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER - AT HIGHWAY #41

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
22 05 79 0600	0426	.30	.22	.016 13F	.004 46F	L.003 66F	.30	.14 19F	L.1
22 05 79 0630	0426	.30	.22	.016	.006	L.003	.31 51F	.14	L.1
04 06 79 1625	0426	.27	.22	.024 13F	.005 46F	.006 66F	.39	.23 19F	L.1
04 06 79 1630	0426	.26	.23	.021	.007	.008	.33 51F	.19	L.1
18 06 79 1555	0426	.085	.077	.016 13F	.008 46F	.005 66F	.15	.04 19F	L.1
18 06 79 1620	0426	.09	.073	.008	.014	.005	.15 51F	.04	L.1
04 07 79 1705	0426			.009 13F	L.003 46F	L.003 66F	.23	.05 19F	L.1
04 07 79 1730	0426			.009	L.003	L.003	.26 51F	.04	L.1
17 07 79 1320	0426	.022	.005	.009 13F	L.003 46F	L.003 66F	.18	L.01 19F	L.1
17 07 79 1325	0426	.007	.007	.007	L.003	L.003	.20 51F	L.01	L.1
30 07 79 1520	0426	.057	.048	.009 13F	.003 46F	L.003 66F	.21	L.01 19F	L.1
30 07 79 1540	0426	.066	.046	.010	L.003	L.003	.27 51F	.06	L.1
17 09 79 1310	0426		.005	.008 13F	.005 46F	L.003 66F	.30	L.01 19F	L.1
17 09 79 1315	0426	.015	.005	.006	L.003	L.003	.26 51F	L.01	L.1
01 10 79 1135	0426	.011	.006	.006 13F	L.003 46F	L.003 66F	.22	L.01 19F	L.1
01 10 79 1140	0426	.018	.003	.005	L.003	L.003	.20 51F	L.01	L.1
17 10 79 0725	0426	.012	.008	.007 13F	.004 46F	L.003 66F	.27	L.01 19F	L.1
17 10 79 0730	0426	.013	.004	.011	.004	L.003	.27 51F	L.01	L.1
05 11 79 1255	0426	.022	.016	.007 13L	.006 46L	L.003 66L	.40 61L	.23 19L	L.1
05 11 79 1300	0426	.023	.017	.006 03L	.006 56L	L.003 56L	.42 51L	.23 10L	L.1
26 11 79 1055	0426	.025	.020	.020 13L	.011 46L	.008 66L	1.3 61L	1.2 19L	L.1
26 11 79 1100	0426	.024	.019	.016 03L	.013 56L	.008 56L	1.3 51L	1.2 10L	L.1
17 12 79 0955	0426	.047	.043	.047 13L	.036 46L	.035 66L	2.3 61L	1.7 19L	.4
17 12 79 1000	0426	.048	.045	.039 03L	.039 56L	.036 56L	2.2 51L	1.6 10L	.4
14 01 80 1040	0426	.086	.076	.078 13L	.069 46L	.069 66L	1.6 61L	1.4 19L	.3
14 01 80 1045	0426	.081	.070	.079 03L	.069 56L	.068 56L	1.7 51L	1.4 10L	.3
04 02 80 1115	0426	.11	.10	.10 13L	.10 46L	.082 66L	1.8 61L	1.5 19L	.3
04 02 80 1120	0426	.12	.11	.11 03L	.10 56L	.10 56L	1.9 51L	1.5 10L	.3
25 02 80 1155	0426	.11	.11	.11 13L	.096 46L	.095 66L	1.5 61L	1.3 19L	.2
25 02 80 1200	0426	.10	.10	.097 03L	.096 56L	.089 56L	1.4 51L	1.3 10L	.1
17 03 80 1115	0426	.19	.17	.15 13L	.14 46L	.14 66L		1.2 19L	.3
17 03 80 1120	0426	.18	.16	.15 03L	.14 56L	.13 56L	1.8 51L	1.4 10L	.4
31 03 80 1125	0426	.11	.10	.080 13L	.072 46L	.059 66L	1.0 61L	.76 19L	L.1
31 03 80 1130	0426	.12	.092	.075 03L	.069 56L	.061 56L	1.0 51L	.80 10L	L.1
14 04 80 1115	0426	.23	.19	.064 13L	.058 46L	.058 66L	1.0 61L	.60 19L	.4
14 04 80 1120	0426	.19	.15	.072 03L	.058 56L	.041 56L	1.1 51L	.66 10L	.4
28 04 80 0955	0426	.20	.14	.051 13F	.029 46F	.020 66F	.48	.17 19F	
28 04 80 1000	0426	.20	.14	.056	.039	.036	.45 51F	.18	
12 05 80 1155	0426	.20	.14	.026 13F	.021 46F	.013 66F		.11 19F	L.1

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2090 LAT. 50D 38M 0S LONG. 110D 12M 0S PR 3 UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER - AT HIGHWAY #41

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103F PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07661F NITROGEN DISSOLVED N MG/L	07110F NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
12 05 80 1200	0426	.16	.15	.026	.015	.010	.25 51F	.07	L.1
26 05 80 1155	0426	.15	.12	.015 13F	.012 46F	.003 66F	.16	.02 19F	L.1
26 05 80 1200	0426	.16	.11	.006	.005	L.003	.16 51F	.01	L.1
09 06 80 1200	0426		.29	.024 03L	.011 56L	.004 56L	.55 61L	.34 10L	L.1
23 06 80 1300	0426	.15	.014	.012		.008	.38	.28	L.1
07 07 80 1140	0426	.060	.046	.009		.009	.15	.01	L.1
16 07 80 1050	0426	.011	.009	.003 03L	L.003 56L	L.003 56L	.15 61L	L.01 10L	L.1
21 07 80 1200	0426	.041	.030	.027	L.003	L.003	.32	.02	L.1
05 08 80 1300	0426	.013	.007	.005	L.003	L.003	.22	L.01	L.1
18 08 80 1210	0426	.018	.009	.007	.004	L.003	.21	L.01	L.1
02 09 80 1215	0426	.011	.008	.003	.003	L.003	.18	L.01	L.1
09 09 80 1205	0426	.008	.004	.003 03L	L.003 56L	L.003 56L	.20 61L	L.01 10L	L.1
15 09 80 1215	0426	.019	.010	.010	.003	L.003	.63	.01	L.1
29 09 80 1200	0426	.017	.008	.007	L.003	L.003	.25	.01	L.1
14 10 80 1215	0426	.023	.016	.006	L.003	L.003	.21	.01	L.1
29 10 80 1315	0426	.053	.036	.011	.006	.004	.82	.70	L.1
10 11 80 0900	0426	.092	.067	.028	.013	.007	.61	.52	L.1
24 11 80 1200	0426	.069	.060	.051	.024	.022	.76	.70	L.1
15 12 80 1220	0426	.074	.051	.074	.040	.019	1.3	1.0	.3
12 01 81 1014	0426	.081	.066	.058	.058	.020	.77	.47	.4
02 02 81 1200	0426	.10	.091	.090	.090	.088	.97	.75	.2
02 02 81 1210	0426	.097	.096	.090	.090	.090	.96	.75	.3
21 02 81 1300	0426	.12	.12	.11	.11	.099	1.3	.94	.2
14 03 81 1240	0426	.080	.080	.045	.045	.045	.79	.70	L.1
01 04 81 1300	0426	.19	.13	.052	.036	.012	.86	.72	L.1
13 04 81 1345	0426	.12	.085	.035	.034	.022	.73	.43	L.1
27 04 81 1300	0426	.088	.043	.015	.006	L.003	.20	L.01	L.1
11 05 81 1130	0426	.14	.10	.024		.005	.23	L.01	L.1
25 05 81 1200	0426	.92	.77	.011	.004	L.003	.69	.48	L.1
08 07 81 1120	0426	.073	.014	.003	L.003	L.003	.12	.01	L.1
12 07 81 1400	0426	.076	.076	.004	L.003	L.003	.12	L.01	L.1
17 08 81 1410	0426	.028	.011	.006	.005	L.003	.17	L.01	L.1
17 08 81 1415	0426	.034	.006	.006	.003	L.003	.14	L.01	L.1
02 09 81 1125	0426	.024	.017	.005	.005	L.003	.17	L.01	L.1
28 09 81 1400	0426	.033	.023	.008	L.003	L.003	.24	L.01	L.1
10 11 81 1100	0426	.069	.051	.007	.003	L.003	1.2	1.0	L.1
15 12 81 1040	0426	.097	.084	.080	.080	.075	1.5	1.1	.4
08 02 82 1200	0426	.22	.18	.19	.18	.17	1.8	1.5	
22 03 82 1140	0426	.18	.17	.15	.15	.14	1.3	1.3	.2

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                                               NAQUADAT DETAILED REPORT
                                            PHOSPHORUS AND NITROGEN FORMS

STATION 00AT05AK2090    LAT. 50D 38M  0S  LONG. 110D 12M  0S   PR 3   UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER                      - AT HIGHWAY #41


                           15406L      15301L      15103F      15356F      15256F      07661F      07110F      07506L
                        PHOSPHOROUS  PHOSPHORUS  PHOSPHORUS  PHOSPHORUS  PHOSPHORUS   NITROGEN    NITROGEN    NITROGEN
                           TOTAL       TOTAL     DISSOLVED   DISSOLVED   DISSOLVED   DISSOLVED   DISSOLVED     TOTAL
  SAMPLE DATE            PHOSPHATE   INORGANIC               INORG. PO4  ORTHO PO4       N       NO3 & NO2    AMMONIA
     MST          SUBM       P           P           P           P           P                       N           N
 D  M  Y  HR       ID      MG/L        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L        MG/L

26 04 82 1330     0426      .22         .19        .076        .068        .062        1.0         .80          .3



                          02061S      02073L      10401L      10501L      07902F      06902F      06104F
                        TEMPERATURE  TURBIDITY    RESIDUE     RESIDUE    NITROGEN     CARBON      CARBON
                            OF                   NONFILTR.     FIXED     PARTICUL.   ORGANIC    DISSOLVED
  SAMPLE DATE             WATER                             NONFILTR.               PARTICULATE  ORGANIC
     MST          SUBM                                                       N           C           C
 D  M  Y  HR       ID     DEG.C.       JTU         MG/L        MG/L        MG/L        MG/L        MG/L

22 05 79 0600     0426     13.         190.        376.        324.         .64
22 05 79 0630     0426     13.         175.        384.        326.         .98
04 06 79 1625     0426     18.         145.        313.        275.        L.01
04 06 79 1630     0426     18.         125.        303.        277.        L.01
18 06 79 1555     0426     18.5         48.         67.         65.         .20

18 06 79 1620     0426     18.5         46.         72.         69.         .16
04 07 79 1705     0426     21.                      56.         48.         .20
04 07 79 1730     0426     21.                      52.         44.
17 07 79 1320     0426     24.5          3.8         4.          3.         .04
17 07 79 1325     0426     24.5          3.8        L1.         L1.

30 07 79 1520     0426     23.          72.        146.1       131.5        .25
30 07 79 1540     0426     23.          63.          9.7         4.8
17 09 79 1310     0426     18.           1.9         1.                     .09
17 09 79 1315     0426                   1.2         1.          1.
01 10 79 1135     0426     11.           1.9         9.          7.         .06

01 10 79 1140     0426     11.           2.4        21.         15.
17 10 79 0725     0426      9.           1.9         5.          4.         .09
17 10 79 0730     0426      9.           2.0         2.         L1.
05 11 79 1255     0426      2.           3.3         6.          5.         .14 02L
05 11 79 1300     0426      2.           2.9         9.          7.

26 11 79 1055     0426      0.           3.9        L1.         L1.         .07 02L
26 11 79 1100     0426      0.           2.8        L1.         L1.
17 12 79 0955     0426      0.           1.3        L1.         L1.         .04 02L
17 12 79 1000     0426      0.           1.0        L1.         L1.
14 01 80 1040     0426      0.           1.5        L1.         L1.         .04 02L     .21 02L     2. 06L

14 01 80 1045     0426      0.           1.6        L1.         L1.                                 2. 04L
04 02 80 1115     0426      0.           1.8         2.         L1.         .04 02L     .22 02L     2. 06L
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NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2090 LAT. 50D 38M 0S LONG. 110D 12M 0S PR 3 UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER - AT HIGHWAY #41

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
04	02	80	1120	0426	0.	1.4	2.	L1.			2. 04L
25	02	80	1155	0426	.5	2.2	7.	6.	.05 02L	.27 02L	2. 06L
25	02	80	1200	0426	.5	2.3	2.	1.			2. 04L
17	03	80	1115	0426	1.5	5.7	9.	8.	.10 02L	.63 02L	3. 06L
17	03	80	1120	0426	1.5	8.4	7.	3.			3. 04L
31	03	80	1125	0426	1. 61F	8.2	16.	16.	.11 02L	.71 02L	4. 06L
31	03	80	1130	0426	1. 61F	8.5	18.	16.			3. 04L
14	04	80	1115	0426	8. 61F	3.7	83.	74.	.24 02L	2.1 02L	3. 06L
14	04	80	1120	0426	8. 61F	3.4	89.	69.			3. 04L
28	04	80	0955	0426	15. 61F	2.5	70.	59.	.73	4.6	4. 06F
28	04	80	1000	0426	15. 61F	27.0	77.	64.			4.
12	05	80	1155	0426	15. 61F	52.0	125.	113.	.27	1.2	2. 06F
12	05	80	1200	0426	15. 61F	37.0	131.	121.			2.
26	05	80	1155	0426	18. 61F	55.	143.	135.	.69	2.4	2. 06F
26	05	80	1200	0426	18. 61F	58.	147.	136.			3.
09	06	80	1200	0426	18. 61F	145.	269.	245.	.61 02L	5.6 02L	4. 04L
23	06	80	1300	0426	20. 61F	48.	138.	127.	.28	2.5	2.
07	07	80	1140	0426		7.1	23.0	19.0	.19	1.2	2.
16	07	80	1050	0426	21.9 61F		4.	3.	.04 02L	.25 02L	3. 04L
21	07	80	1200	0426	22.0 61F	35.	83.	76.	.20	1.7	3.
05	08	80	1300	0426	18.0 61F	4.8	6.	5.	.05	.34	4.
18	08	80	1210	0426	20.0 61F	6.0	8.	6.	.04	.36	3.
02	09	80	1215	0426	19. 61F	4.9	8.	6.	.05	.32	3.
09	09	80	1205	0426	16.7 61F		3.	2.	.04 02L	.26 02L	3. 04L
15	09	80	1215	0426	14. 61F	5.9	9.	7.	.17	.81	4.
29	09	80	1200	0426	17. 61F	6.0	10.	8.	.10	.45	3.
14	10	80	1215	0426	11. 61F	8.5	12.	10.	.11	1.1	3.
29	10	80	1315	0426	9. 61F	18.	31.	26.	.16	1.0	2.
10	11	80	0900	0426	2. 61F	18.	37.	33.	.19	1.3	2.
24	11	80	1200	0426		9.5	24.	21.	.14	.95	2.
15	12	80	1220	0426		12.	21.	19.	.14		2.
12	01	81	1014	0426	0. 61F	6.7	9.	7.	.04	.25	2.
02	02	81	1200	0426		4.0	3.	2.	.06	.26	2.
02	02	81	1210	0426		6.8	4.	3.	.04	.16	2.
21	02	81	1300	0426		7.1	10.	7.	.12	.38	2.
14	03	81	1240	0426		4.4	14.	11.	.11	.50	2.
01	04	81	1300	0426	8.0 61F	36.0	82.	77.	.43	2.7	2.
13	04	81	1345	0426	5.0 61F	19.0	43.	39.	.31	1.6	2.
27	04	81	1300	0426	13.0 61F	7.0	28.	24.	.40	2.6	3.

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AT05AK2090 LAT. 50D 38M 0S LONG. 110D 12M 0S PR 3 UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER - AT HIGHWAY #41

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902F NITROGEN PARTICUL. N MG/L	06902F CARBON ORGANIC PARTICULATE C MG/L	06104F CARBON DISSOLVED ORGANIC C MG/L
11	05	81	1130	0426	12.0 61F	64.	314.	289.	.39	2.6	3.
25	05	81	1200	0426	15.0 61F	230.	1908.	1872.			5.
08	07	81	1120	0426	19.8 61F		83.	77.	.12	.68	3.
12	07	81	1400	0426	21.0 61F	23.	48.	43.	.13	.86	2.
17	08	81	1410	0426	24. 61F	8.8	21.	18.	.15	.87	2.
17	08	81	1415	0426	24. 61F	9.5	25.	21.	.14	.87	2.
02	09	81	1125	0426	16. 61F		16.	10.			2.
28	09	81	1400	0426	11. 61F	9.9	19.	18.	.18	1.1	3.
10	11	81	1100	0426	4. 61F	18.0	29.	28.	.31	2.1	4.
15	12	81	1040	0426	.0 61F	2.4	2.0	1.0	.05	.21	3.
08	02	82	1200	0426	.0 61F	3.3	2.	1.	.05	.27	2.
22	03	82	1140	0426	4. 61F	6.7	8.	5.	.12	.75	3.
26	04	82	1330	0426	10.0 61F	45.	92.	83.	.43	2.9	4.

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
22	05	79	0600	0426	8.0		113.	.0	334.		
22	05	79	0630	0426	8.0		114.	.0	334.		
04	06	79	1625	0426	8.0		112.	.0	308.		
04	06	79	1630	0426	8.0		110.	.0	308.		
18	06	79	1555	0426	8.3		119.	.0	308.		
18	06	79	1620	0426	8.3		118.	.0	308.		
04	07	79	1705	0426	8.3		115.	.0	368.		
04	07	79	1730	0426	8.3		113.	.0	359.		
17	07	79	1320	0426	8.6		95.		352.		
17	07	79	1325	0426	8.6		97.		346.		
30	07	79	1520	0426	8.7		86.	13.	359.		
30	07	79	1540	0426	8.8		83.	19.	369.		
17	09	79	1310	0426	8.6		114.	6.4	467.		
17	09	79	1315	0426	8.6		115.	1.5	466.		
01	10	79	1135	0426	8.3		112.	.0	482.		
01	10	79	1140	0426	8.3		112.	.0	471.		

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                                                        NAQUADAT DETAILED REPORT
                                                       PH DIC ALK COND CL SIO2

STATION 00AT05AK2090    LAT. 50D 38M  0S  LONG. 110D 12M  0S   PR 3   UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER                        - AT HIGHWAY #41

                            10301L      06152F      10106L      10151L      02041L      17206L      14105L
                              PH        CARBON     ALKALINITY  ALKALINITY  SPECIFIC    CHLORIDE    SILICA
                                       DISSOLVED     TOTAL       PHENOL     CONDUCT.   DISSOLVED   REACTIVE
  SAMPLE DATE                          INORGANIC     CACO3     PHTHALEIN
      MST          SUBM                    C                     CACO3                    CL         SIO2
 D  M  Y  HR        ID      PH UNITS     MG/L        MG/L        MG/L        US/CM       MG/L        MG/L

17 10 79 0725      0426       8.3                    126.          .0         519.
17 10 79 0730      0426       8.3                    125.          .0         520.
05 11 79 1255      0426       8.3                    136.          .0         510.
05 11 79 1300      0426       8.3                    136.          .0         512.
26 11 79 1055      0426       8.1                    130.          .0         506.

26 11 79 1100      0426       8.2                    137.          .0         497.
17 12 79 0955      0426       8.1                    180.          .0         594.
17 12 79 1000      0426       8.1                    180.          .0         600.
14 01 80 1040      0426       7.8        35. 53L     166.          .0         533.                    1.1
14 01 80 1045      0426       7.9        35. 52L     166.          .0         529.                    1.2

04 02 80 1115      0426       7.9        39. 53L     176.          .0         557.                     .7
04 02 80 1120      0426       7.9        40. 52L     182.          .0         564.                     .6
25 02 80 1155      0426       8.0        31. 53L     166.          .0         524.                     .9
25 02 80 1200      0426       8.2        32. 52L     167.          .0         520.                    1.0
17 03 80 1115      0426       7.7        28. 53L     102.          .0         504.                    2.9

17 03 80 1120      0426       7.7        29. 52L     126.          .0         499.                    3.0
31 03 80 1125      0426       8.4        17. 53L     120. 01L     7.7         311.        6.8          .8
31 03 80 1130      0426       8.4        18. 52L     110. 01L      .0         312.        6.7         1.9
14 04 80 1115      0426       8.0        25. 53L     120. 01L      .0         434.        5.7         2.4
14 04 80 1120      0426       8.0        26. 52L     120. 01L      .0         434.        5.9         2.6

28 04 80 0955      0426       8.3        26. 53F     150. 01L    0.           458.        5.0         1.5
28 04 80 1000      0426       8.3        26.         150. 01L    0.           458.        4.9         1.5
12 05 80 1155      0426       8.3        23. 53F     121. 01L    0.           328.        2.6         2.3
12 05 80 1200      0426       8.3        23.         121. 01L    0.           326.        2.6         2.3
26 05 80 1155      0426       8.4        24. 53F     114. 01L                 382.        3.5          .7

26 05 80 1200      0426       8.4        25.         124. 01L      .0         368.        3.5          .9
09 06 80 1200      0426       8.0        23. 52L     113. 01L      .0         318.        1.8         4.3
23 06 80 1300      0426       8.1        22.         110. 01L      .0         299.        1.5         3.5
07 07 80 1140      0426       8.5        22.         105. 01L     4.8         335.        2.6          .4
16 07 80 1050      0426       8.2        25. 52L     112. 01L      .0         376.        3.8          .6

21 07 80 1200      0426       8.4        23.         110. 01L     1.3         398.        4.5          .9
05 08 80 1300      0426       8.8        22.         104. 01L     6.6         402.        5.0          .6
18 08 80 1210      0426       8.7        22.         106. 01L      .1         378.        4.6          .4
02 09 80 1215      0426       8.6        22.         108. 01L     1.5         392.        5.3          .7
09 09 80 1205      0426       8.6        22. 52L     107. 01L      .0         400.        5.6          .3

15 09 80 1215      0426       8.5        27.         115. 01L     2.1         426.        6.5          .4
29 09 80 1200      0426       8.5        30.         131. 01L     3.0         454.        5.6          .4
14 10 80 1215      0426       8.4        28.         124. 01L     1.9         393.        4.4          .5
29 10 80 1315      0426       8.5                    142. 01L      .0         435.        5.2         1.3
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NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AT05AK2090 LAT. 50D 38M 0S LONG. 110D 12M 0S PR 3 UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER - AT HIGHWAY #41

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10106L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
10 11 80 0900	0426	8.3	37.	135. 01L	.0	388.	4.5	.7
24 11 80 1200	0426	8.2	36.	143. 01L	.0	426.	5.0	.8
15 12 80 1220	0426	8.0	43.	181. 01L	.0	548.	9.0	1.0
12 01 81 1014	0426	8.0		140. 01L	.0	412.	5.9	4.5
02 02 81 1200	0426	8.0	34.	140. 01L	.0	423.	4.9	3.4
02 02 81 1210	0426	8.0	34.	141. 01L	.0	423.	4.9	3.3
21 02 81 1300	0426	7.8	34.	142. 01L	.0	448.	6.0	3.0
14 03 81 1240	0426	8.4	32.	129. 01L	2.3	414.	6.0	1.0
01 04 81 1300	0426	8.5	43.	148. 01L	.0	480.	6.9	.7
13 04 81 1345	0426	8.7	34.	149. 01L	7.	470.	6.4	.1
27 04 81 1300	0426	8.7	27.	106. 01L	6.0	377.	6.7	L.1
11 05 81 1130	0426	8.8	28.	115. 01L	4.0	334.	3.1	1.6
25 05 81 1200	0426	7.8	27.	121. 01L	.0	348.	1.7	5.8
08 07 81 1120	0426	8.4	28.	118. 01L	.0	320.	2.5	1.6
12 07 81 1400	0426	8.6	30.	126. 01L	1.9	326.	2.0	.7
17 08 81 1410	0426	8.6	27.	114. 01L	1.8	316.	2.8	1.4
17 08 81 1415	0426	8.6	28.	114. 01L	3.3	317.	2.8	1.6
02 09 81 1125	0426	8.4	28.	112. 01L	.2	334.	3.3	.4
28 09 81 1400	0426	8.5	20.	119. 01L	.2	394.	5.8	L.1
10 11 81 1100	0426	8.3	26.	148. 01L	.0	452.	7.1	.2
15 12 81 1040	0426	8.2	44.	187. 01L	.0	534.	8.6	1.0
08 02 82 1200	0426	7.5	47.	185. 01L	.0	489.	7.9	4.3
22 03 82 1140	0426	7.7	36.	140. 01L	.0	418.	7.9	2.6
26 04 82 1330	0426	8.0	25.	115. 01L	.0	357.	6.5	3.9

B-2 NAQUADAT printout of algal growth potential and biologically available phosphorus

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REQUEST 0001 PAGE   1                                   NAQUADAT DETAILED REPORT
                                                     AGP PBAP AND DBAP

STATION 00AT05AD2035     LAT. 48D 42M 37S  LONG. 112D 51M 42S   PR 3   UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3,                ABOVE LETHBRIDGE STP OUTFALL


                            54101L       54611L         54601L
                           FILTERED    PARTICULATE     DISSOLVED
                         ALGAL GROWTH BIOLOGICALLY   BIOLOGICALLY
   SAMPLE DATE             POTENTIAL    AVAILABLE      AVAILABLE
       MST           SUBM SELENASTRUM  PHOSPHORUS     PHOSPHORUS
  D  M  Y  HR         ID   CELLS/ML       MG/L           MG/L

 23 05 79 0900       0426     17.
 05 06 79 1400       0426     12.
 19 06 79 1140       0426      3.
 05 07 79 1315       0426      2.        .000
 18 07 79 1120       0426      9.

 31 07 79 1600       0426      2.        .003
 18 09 79 1345       0426      2.        .003
 02 10 79 1300       0426      7.        .005
 18 10 79 0930       0426      6.        .005
 06 11 79 1330       0426      5.        .002

 27 11 79 0900       0426      4.        .002
 15 01 80 1100       0426      2.        .003
 05 02 80 0945       0426      1.        .006           .002
 26 02 80 0915       0426     35.        .004           .002
 18 03 80 1330       0426     17.        .007           .003

 01 04 80 0910       0426      3.        .007           .003
 15 04 80 1000       0426      3.        .003           .001
 29 04 80 1430       0426      7.        .027           .001
 13 05 80 1325       0426      4.        .003           .001
 27 05 80 1400       0426     10.        .288           .002

 10 06 80 1330       0426      4.        .005           .001
 24 06 80 1320       0426      3.        .005           .001
 08 07 80 1500       0426      2.        .002           .001
 22 07 80 1330       0426      7.        .002           .001
 06 08 80 1330       0426      4.        .002           .001

 19 08 80 1210       0426      2.        .012           .001
 03 09 80 1215       0426      1.        .001           .001
 16 09 80 1200       0426      4.        .001           .002
 30 09 80 1600       0426      3.        .003           .001
 15 10 80 1215       0426      1.        .001           .001

 30 10 80 1220       0426      6.        .001           .001
 11 11 80 1600       0426      7.        .002           .001
 25 11 80 1320       0426      5.        .001           .001
 13 01 81 1310       0426      4.        .001           .001
 03 02 81 1400       0426      1.        .003           .001

 22 02 81 1700       0426      4.        .015           .002
 15 03 81 1330       0426      4.        .002           .001
 02 04 81 1400       0426      5.        .002           .001
 14 04 81 1430       0426      4.        .000           .001
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                                                      NAQUADAT DETAILED REPORT
                                             AGP PBAP AND DBAP

STATION 00AT05AD2035    LAT. 48D 42M 37S  LONG. 112D 51M 42S   PR 3   UTM 12 363050E 5396700N
OLDMAN RIVER AT HIGHWAY #3,               ABOVE LETHBRIDGE STP OUTFALL


                             54101L        54611L        54601L
                            FILTERED     PARTICULATE    DISSOLVED
                          ALGAL GROWTH  BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE               POTENTIAL     AVAILABLE     AVAILABLE
      MST            SUBM SELENASTRUM    PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR          ID    CELLS/ML        MG/L          MG/L

28 04 81 1335      0426        15.          .034          .001
12 05 81 1315      0426         7.          .002          .010
26 05 81 1630      0426        12.          .070          .002
16 06 81 1315      0426        15.          .053          .005
13 07 81 1345      0426         2.          .002          .001

28 07 81 1655                   4.
09 09 81 1315                   3.
29 09 81 1525                   3.




STATION 00AT05AD2050    LAT. 49D 51M 30S  LONG. 112D 37M 24S   PR 3   UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845,             BELOW LETHBRIDGE (BELOW PICTURE BUTTE)


                             54101L        54611L        54601L
                            FILTERED     PARTICULATE    DISSOLVED
                          ALGAL GROWTH  BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE               POTENTIAL     AVAILABLE     AVAILABLE
      MST            SUBM SELENASTRUM    PHOSPHORUS    PHOSFHORUS
 D  M  Y  HR          ID    CELLS/ML        MG/L          MG/L

23 05 79 0605      0426        45.
05 06 79 1155      0426        53.
19 06 79 0940      0426        20.
05 07 79 1130      0426         6.          .004
18 07 79 0935      0426         4.

31 07 79 1415      0426        29.          .011
18 09 79 1200      0426        59.          .008
02 10 79 1130      0426        13.          .012
18 10 79 0730      0426       288.          .024
06 11 79 1230      0426        76.          .008

27 11 79 0800      0426       117.          .005
15 01 80 0915      0426      1110.          .017
05 02 80 0845      0426      1370.          .009
26 02 80 0815      0426       963.          .020          .229
18 03 80 1150      0426       493.          .043          .106

01 04 80 0820      0426       105.          .037          .116
15 04 80 0830      0426        73.          .013          .112
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REQUEST 0001 PAGE   3                                         NAQUADAT DETAILED REPORT
                                                      AGP PBAP AND DBAP

STATION 00AT05AD2050     LAT. 49D 51M 30S  LONG. 112D 37M 24S    PR 3   UTM 12 383300E 5523900N
OLDMAN RIVER AT HIGHWAY #845,              BELOW LETHBRIDGE (BELOW PICTURE BUTTE)


                               54101L        54611L        54601L
                              FILTERED     PARTICULATE    DISSOLVED
                            ALGAL GROWTH  BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE                POTENTIAL     AVAILABLE      AVAILABLE
      MST            SUBM  SELENASTRUM    PHOSPHORUS     PHOSPHORUS
 D   M  Y   HR        ID     CELLS/ML        MG/L          MG/L

20 04 80 1200                  156.          .062          .042
13 05 80 1200        0426       29.          .017          .030
27 05 80 1130        0426       21.          .361          .002
10 06 80 1130        0426       33.                        .001
24 06 80 1130        0426       44.          .008          .021

08 07 80 1230        0426       13.          .008          .089
22 07 80 1145        0426       10.          .004          .069
06 08 80 1145        0426       19.          .004          .025
19 08 80 1030        0426        5.          .018          .100
03 09 80 1100        0426       15.          .009          .130

16 09 80 1045        0426       36.          .008          .115
30 09 80 1430        0426       61.          .009          .041
15 10 80 1045        0426       72.          .004          .047
30 10 80 1130        0426      189.          .010          .012
11 11 80 1435        0426      238.          .008          .017

25 11 80 1200        0426       87.          .005          .020
13 01 81 1140        0426      127.          .011          .080
03 02 81 1245        0426      223.          .005          .093
22 02 81 1600        0426      309.          .047          .029
15 03 81 1230        0426       81.          .013          .088

02 04 81 1200        0426       96.          .018          .090
14 04 81 0300        0426       37.          .000          .113
28 04 81 1200        0426      273.          .023          .035
12 05 81 1145        0426       52.          .006          .021
26 05 81 1400        0426        9.          .056          .001

16 06 81 1100        0426       38.          .096          .012
13 07 81 1155        0426        4.          .000          .001
28 07 81 1545                   32.
09 09 81 1150                   36.
29 09 81 1350                   22.
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NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05AG2095 LAT. 49D 56M 2S LONG. 111D 41M 48S PR 3 UTM 12 450000E 5531300N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
22 05 79 1700	0426	39.		
05 06 79 0915	0426	92.		
19 06 79 0735	0426	26.		
05 07 79 0850	0426	5.	.004	
18 07 79 0715	0426	8.		
31 07 79 1115	0426	3.	.003	
18 09 79 0915	0426	18.	.005	
02 10 79 0830	0426	9.	.007	
17 10 79 1630	0426	11.	.021	
06 11 79 1000	0426	26.	.004	
26 11 79 1530	0426	91.	.005	
14 01 80 1535	0426	109.	.009	
04 02 80 1615	0426	1190.	.008	
25 02 80 1710	0426	1500.	.007	.247
18 03 80 0830	0426	455.	.010	.121
31 03 80 1720	0426	49.	.003	.051
14 04 80 1710	0426		.016	.095
14 04 80 1715	0426	745.		
29 04 80 0830	0426	160.	.074	.030
13 05 80 0910	0426	73.	.031	.014
27 05 80 0745	0426	76.	.169	.007
10 06 80 0830	0426	18.		.001
24 06 80 0915	0426	67.	.020	.009
08 07 80 0830	0426	14.	.008	.004
22 07 80 0900	0426	9.	.002	.001
06 08 80 0930	0426	2.	.001	.001
19 08 80 0820	0426	15.	.004	.002
03 09 80 0900	0426	18.	.003	.003
16 09 80 0830	0426	12.	.001	.002
30 09 80 0830	0426	90.	.015	.011
15 10 80 0830	0426	44.	.007	.017
30 10 80 0930	0426	21.	.005	.003
11 11 80 1045	0426	38.	.007	.004
25 11 80 0930	0426	24.	.006	.003
13 01 81 0900	0426	149.	.008	.025
03 02 81 1030	0426	18.	.002	.004
22 02 81 1200	0426	183.	.023	.016
15 03 81 1020	0426	19.	.016	.040
02 04 81 0930	0426	73.	.020	.043

NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05AG2095 LAT. 49D 56M 2S LONG. 111D 41M 48S PR 3 UTM 12 450000E 5531300N
OLDMAN RIVER AT THE MOUTH

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
14 04 81 1015	0426	24.	.002	.058
28 04 81 0830	0426	306.	.040	.017
12 05 81 0830	0426	32.	.004	.052
26 05 81 0930	0426	46.	.072	.005
15 06 81 1815	0426	12.	.135	.002
21 07 81 1520		2.		
28 07 81 1220		2.		
09 09 81 0925		2.		
29 09 81 1135		3.		

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
15 05 79 1855	0426	23.		
29 05 79 1431	0426	30.		
12 06 79 1500	0426	118.		
26 06 79 1300	0426	31.	.015	
10 07 79 1215	0426	5.	.006	
24 07 79 1235	0426	31.		
06 08 79 1305	0426	3.	.003	
21 08 79 1435	0426	9.	.005	
25 09 79 0745	0426	6.		
10 10 79 0700	0426	8.	.008	
30 10 79 0800	0426	8.	.008	
19 11 79 1530	0426	636.	.012	
10 12 79 1545	0426	1540.	.011	
08 01 80 1420	0426	1940.	.030	
29 01 80 1345	0426	1790.	.016	
19 02 80 1320	0426	1090.	.021	

NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05AK2070 LAT. 49D 54M 15S LONG. 111D 31M 42S PR 3 UTM 12 462050E 5527900N
SOUTH SASKATCHEWAN RIVER AT HIGHWAY #879

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
11 03 80 1330	0426	1270.	.076	.181
25 03 80 1140	0426			.165
09 04 80 1350	0426	544.	.179	.032
22 04 80 1530	0426	966.	.123	.094
06 05 80 1325	0426	109.	.061	.026
22 05 80 1115	0426	10.	.017	.008
04 06 80 1100	0426	414.	.098	.017
18 06 80 0800	0426	333.	.052	.034
02 07 80 1545	0426	145.	.039	.016
16 07 80 0820	0426	14.	.001	.001
30 07 80 0830	0426	7.	.002	.002
13 08 80 0730	0426	9.	.008	.002
26 08 80 1630	0426	3.	.009	.001
09 09 80 1510	0426	7.	.002	.001
23 09 80 1410	0426	4.	.003	.002
07 10 80 1410	0426	10.	.005	.003
22 10 80 0810	0426	706.	.057	.048
05 11 80 0930	0426	745.	.029	.078
19 11 80 0820	0426	642.	.015	.085
10 12 80 0900	0426	1070.		.150
07 01 81 0800	0426	643.	.003	.016
28 01 81 0900	0426	1214.	.008	.179
17 02 81 1600	0426	910.	.019	.123
10 03 81 1500	0426	1124.	.032	.138
22 03 81 0830	0426	612.	.026	.078
07 04 81 1700	0426	779.	.013	.122
22 04 81 1415	0426	309.	.020	.084
05 05 81 1345	0426	199.	.028	.034
20 05 81 1445	0426	313.	.073	.025
15 06 81 1630	0426	279.	.070	.024
27 07 81 1650		189.		
08 09 81 1700		9.		

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REQUEST 0001 PAGE   7                                       NAQUADAT DETAILED REPORT
                                                         AGP PBAP AND DBAP

STATION 00AT05AK2080    LAT. 50D  2M 36S  LONG. 110D 43M 20S   PR 0   UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE            MEDICINE HAT

                              54101L        54611L        54601L
                             FILTERED     PARTICULATE     DISSOLVED
                           ALGAL GROWTH  BIOLOGICALLY   BIOLOGICALLY
                             POTENTIAL     AVAILABLE      AVAILABLE
  SAMPLE DATE               SELENASTRUM   PHOSPHORUS     PHOSPHORUS
     MST             SUBM   CELLS/ML        MG/L           MG/L
 D  M  Y  HR          ID

22 05 79 1300      0426        93.
04 06 79 1200      0426       131.
18 06 79 1130      0426        14.
04 07 79 1145      0426         5.          .003
17 07 79 1545      0426         5.

31 07 79 0630      0426         3.          .003
18 09 79 0615      0426         8.          .003
01 10 79 1700      0426         4.          .004
17 10 79 1400      0426         8.          .007
06 11 79 0800      0426        15.          .010

26 11 79 1400      0426       499.          .005
14 01 80 1400      0426      1600.          .010
04 02 80 1435      0426      1810.          .011
25 02 80 1445      0426      1940.          .012          .153
17 03 80 1600      0426      1020.                        .128

31 03 80 1535      0426       578.          .005          .087
14 04 80 1335      0426       694.          .075          .048
28 04 80 1815      0426       181.          .051          .047
12 05 80 1820      0426       107.          .029          .011
26 05 80 1855      0426       217.          .185          .021

09 06 80 1600      0426       196.
23 06 80 1815      0426       261.          .025          .029
07 07 80 1900      0426         1.          .009          .001
21 07 80 1730      0426         3.          .001          .001
05 08 80 1830      0426         2.          .002          .001

18 08 80 1630      0426         2.          .005          .001
02 09 80 1630      0426         2.          .001          .001
15 09 80 1600      0426         4.          .004          .001
29 09 80 1700      0426         1.          .015          .002
14 10 80 1630      0426         2.          .009          .001

29 10 80 1700      0426       346.          .012          .040
10 11 80 1300      0426       288.          .016          .031
24 11 80 1600      0426       511.          .012          .045
12 01 81 1500      0426       377.          .004          .033
02 02 81 1600      0426       857.          .009          .138

21 02 81 1630      0426       642.          .003          .100
14 03 81 1610      0426       426.          .300          .048
01 04 81 1730      0426       362.          .052          .070
13 04 81 1830      0426       187.          .002          .051
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REQUEST 0001 PAGE   8                                      NAQUADAT DETAILED REPORT
                                                         AGP PBAP AND DBAP

STATION 00AT05AK2080    LAT. 50D  2M 36S  LONG. 110D 43M 20S   PR 0   UTM 12 519894E 5543261N
SOUTH SASKATCHEWAN RIVER ABOVE            MEDICINE HAT


                              54101L        54611L        54601L
                             FILTERED     PARTICULATE    DISSOLVED
                           ALGAL GROWTH  BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE                POTENTIAL     AVAILABLE     AVAILABLE
      MST             SUBM SELENASTRUM    PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR           ID    CELLS/ML       MG/L          MG/L

27 04 81 1720  0426       47.          .510          .056
11 05 81 1630  0426      112.          .006          .054
25 05 81 1800  0426       17.          .125          .001
12 07 81 1630  0426        3.          .008          .001
28 09 81 1850              3.



STATION 00AT05AK2087    LAT. 50D  8M 30S  LONG. 110D 39M 28S   PR 3   UTM 12 524450E 5554200N
SOUTH SASKATCHEWAN RIVER                  BELOW MEDICINE HAT


                              54101L        54611L        54601L
                             FILTERED     PARTICULATE    DISSOLVED
                           ALGAL GROWTH  BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE                POTENTIAL     AVAILABLE     AVAILABLE
      MST             SUBM SELENASTRUM    PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR           ID    CELLS/ML       MG/L          MG/L

22 05 79 1050  0426       97.
04 06 79 1400  0426      126.
18 06 79 1330  0426       21.
04 07 79 1400  0426       10.          .002
17 07 79 1015  0426       17.

31 07 79 0835  0426       13.
17 09 79 0530  0426        2.          .005
01 10 79 1525  0426      160.          .010
17 10 79 1220  0426       32.          .011
05 11 79 1600  0426      160.          .013

26 11 79 1300  0426      532.          .009
14 01 80 1230  0426     1930.          .021
04 02 80 1400  0426     1790.          .023
25 02 80 1415  0426     1530.          .023
17 03 80 1520  0426     1020.          .032          .158

31 03 80 1420  0426      683.          .030          .087
14 04 80 1445  0426      923.          .079          .071
28 04 80 1330  0426      314.          .136          .057
12 05 80 1610  0426      155.          .060          .024
26 05 80 1630  0426       89.          .094          .011

09 06 80 1545  0426      175.          .065          .017
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NAQUADAT DETAILED REPORT
AGP FBAP AND DBAP

STATICN 00AT05AK2087 LAT. 50D 8M 30S LONG. 110D 39M 28S PR 3 UTM 12 524450E 5554200N
SOUTH SASKATCHEWAN RIVER BELOW MEDICINE HAT

SAMPLE DATE MST D	M	Y	HR	SUBM ID	54101L FILTERED ALGAL GROWTH FOTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
23	06	80	1600	0426	216.	.031	.026
07	07	80	1500	0426	2.	.011	.001
21	07	80	1600	0426	5.	.003	.001
05	08	80	1545	0426	2.	.015	.001
18	08	80	1445	0426	2.	.012	.001
02	09	80	1440	0426	1.	.005	.001
15	09	80	1515	0426	27.	.001	.002
29	09	80	1500	0426	1.	.017	.001
14	10	80	1500	0426	2.	.006	.001
29	10	80	1510	0426	173.	.008	.005
10	11	80	1530	0426	502.	.015	.033
24	11	80	1450	0426	541.	.015	.042
12	01	81	1410	0426	502.	.003	.062
02	02	81	1500	0426	841.	.004	.143
22	02	81	0930	0426	794.	.006	.121
14	03	81	1440	0426	687.	.023	.064
01	04	81	1600	0426	448.	.030	.072
13	04	81	1700	0426	312.	.003	.059
27	04	81	1600	0426	323.	.030	.004
11	05	81	1430	0426	152.	.024	.050
25	05	81	1330	0426	11.	.250	.002
15	06	81	1300	0426	194.	.026	.017
27	07	81	1915		27.		
08	09	81	1440		2.		

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REQUEST 0001 PAGE  10                                       NAQUADAT DETAILED REPORT
                                                       AGP PBAP AND DBAP

STATION 00AT05AK2090    LAT. 50D 38M  0S  LONG. 110D 12M  0S   PR 3   UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER                              - AT HIGHWAY #41


                            54101L       54611L        54601L
                           FILTERED    PARTICULATE    DISSOLVED
                         ALGAL GROWTH BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE              POTENTIAL   AVAILABLE      AVAILABLE
      MST            SUBM SELENASTRUM  PHOSPHORUS    PHOSPHORUS
  D  M  Y  HR         ID   CELLS/ML      MG/L           MG/L

 22 05 79 0630      0426      102.
 04 06 79 1630      0426      132.
 18 06 79 1620      0426       13.
 04 07 79 1730      0426        8.        .005
 17 07 79 1325      0426        6.

 30 07 79 1540      0426        3.        .003
 17 09 79 1315      0426        6.        .004
 01 10 79 1140      0426        5.        .004
 17 10 79 0730      0426        1.        .002
 05 11 79 1300      0426        7.        .009

 26 11 79 1100      0426       60.        .006
 14 01 80 1045      0426      672.        .031
 04 02 80 1120      0426     1630.        .008
 25 02 80 1200      0426      916.        .010           .100
 17 03 80 1120      0426     1330.        .035           .114

 31 03 80 1130      0426      703.        .009           .077
 14 04 80 1120      0426      224.        .049           .006
 28 04 80 1000      0426      136.        .136           .029
 12 05 80 1200      0426       91.        .048           .026
 26 05 80 1200      0426       11.        .047           .002

 09 06 80 1200      0426      145.        .060           .015
 23 06 80 1300      0426      220.        .044           .011
 07 07 80 1140      0426       13.        .018           .002
 21 07 80 1200      0426        3.        .002           .003
 05 08 80 1300      0426        2.        .002           .001

 18 08 80 1210      0426        1.        .003           .001
 02 09 80 1215      0426        2.        .001           .001
 15 09 80 1215      0426       26.        .002           .003
 29 09 80 1200      0426        1.        .003           .002
 14 10 80 1215      0426        1.        .007           .001

 29 10 80 1315      0426       42.        .010           .006
 10 11 80 0900      0426      247.        .023           .016
 24 11 80 1200      0426      393.        .010           .032
 12 01 81 1014      0426      501.        .007           .053
 02 02 81 1200      0426     1083.        .006           .086

 21 02 81 1300      0426     1012.        .006           .131
 14 03 81 1240      0426      372.        .012           .032
 01 04 81 1300      0426      439.        .060           .034
 13 04 81 1345      0426      389.        .004           .028
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REQUEST 0001 PAGE  11                                  NAQUADAT DETAILED REPORT
                                                    AGP PBAP AND DBAP

STATION 00AT05AK2090    LAT. 50D 38M  0S  LONG. 110D 12M  0S   PR 3   UTM 12 556600E 5609150N
SOUTH SASKATCHEWAN RIVER                             - AT HIGHWAY #41

                             54101L       54611L        54601L
                            FILTERED    PARTICULATE    DISSOLVED
                          ALGAL GROWTH BIOLOGICALLY  BIOLOGICALLY
    SAMPLE DATE             POTENTIAL    AVAILABLE     AVAILABLE
        MST            SUBM SELENASTRUM  PHOSPHORUS    PHOSPHORUS
   D  M  Y  HR          ID   CELLS/ML      MG/L          MG/L

  27 04 81 1300        0426     39.         .025          .013
  11 05 81 1130        0426     66.         .007          .033
  25 05 81 1200        0426     20.         .357          .003
  12 07 81 1400        0426      3.         .012          .001
  28 09 81 1530                  3.


STATION 00AT05BH2105    LAT. 51D  6M  0S  LONG. 114D 12M 36S   PR 3   UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

                             54101L       54611L        54601L
                            FILTERED    PARTICULATE    DISSOLVED
                          ALGAL GROWTH BIOLOGICALLY  BIOLOGICALLY
    SAMPLE DATE             FOTENTIAL    AVAILABLE     AVAILABLE
        MST            SUBM SELENASTRUM  PHOSPHORUS    PHOSPHORUS
   D  M  Y  HR          ID   CELLS/ML      MG/L          MG/L

  14 05 79 1015        0426      6.
  28 05 79 0840        0426      9.
  11 06 79 0800        0426      4.
  25 06 79 0855        0426     39.         .005
  09 07 79 1230        0426     14.         .002

  23 07 79 1300        0426     24.
  05 08 79 0720        0426      2.         .001
  20 08 79 1145        0426      1.         .001
  23 09 79 1235        0426     13.         .001
  08 10 79 1130        0426     38.         .001

  28 10 79 1500        0426     11.         .004
  18 11 79 1300        0426      9.         .004
  09 12 79 1645        0426      3.         .003
  07 01 80 1430        0426     12.         .008
  28 01 80 1145        0426      1.         .001

  18 02 80 1215        0426     19.         .002
  10 03 80 0830        0426      8.         .002          .005
  24 03 80 1545        0426                               .003
  08 04 80 1140        0426      2.         .015          .001
  21 04 80 1230        0426      4.         .001          .001

  05 05 80 0610        0426      6.         .001          .001
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NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05BH2105 LAT. 51D 6M 0S LONG. 114D 12M 36S PR 3 UTM 11 695350E 5664400N
BOW RIVER AT 85ST. BRIDGE CALGARY

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
20 05 80 0600	0426	1.	.001	.001
02 06 80 1245	0426	1.	.002	.001
16 06 80 0715	0426	1.	.002	.001
01 07 80 0700	0426	2.	.001	.001
14 07 80 1400	0426	3.	.001	.001
28 07 80 0700	0426	1.	.001	.001
11 08 80 0730	0426	4.	.001	.001
25 08 80 0700	0426	2.	.001	.001
08 09 80 0800	0426	1.	.001	.001
22 09 80 0730	0426	1.	.001	.001
06 10 80 0700	0426	3.	.001	.001
20 10 80 0830	0426	2.	.001	.001
03 11 80 0915	0426	2.	.001	.002
18 11 80 0800	0426	2.	.001	.002
08 12 80 1320	0426	1.	.001	.001
05 01 81 0800	0426	26.	.000	.004
26 01 81 0830	0426	2.	.001	.001
16 02 81 0800	0426	9.	.003	.003
09 03 81 0800	0426	5.	.001	.001
06 04 81 0900	0426	3.	.000	.001
21 04 81 0800	0426	3.	.000	.000
04 05 81 0800	0426	2.	.001	.001
19 05 81 0915	0426	4.	.003	.001
09 06 81 0830	0426	7.	.001	.002
30 06 81 0800	0426	4.	.004	.007
20 07 81 1015		2.		
20 07 81 1030		2.		
24 08 81 1155		1.		
21 09 81 1525		5.		
15 10 81 1400		3.		

NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05BM2161 LAT. 50D 53M 34S LONG. 114D 27M 0S PR 3 UTM 11 679350E 5640800N
BOW RIVER AT HIGHWAY 22X, CALGARY

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
14 05 79 1430	0426	422.		
28 05 79 1215	0426	420.		
11 06 79 1050	0426	816.		
25 06 79 1110	0426	785.	.018	
09 07 79 0950	0426	413.	.009	
23 07 79 0925	0426	551.		
05 08 79 1345	0426	736.	.004	
20 08 79 0945	0426	583.	.014	
23 09 79 1450	0426	1265.	.031	
08 10 79 1330	0426	1818.	.043	
28 10 79 1700	0426	1540.	.046	
18 11 79 1530	0426	1660.	.040	
09 12 79 1530	0426	2190.	.050	
07 01 80 1315	0426	2760.	.077	
28 01 80 0945	0426	2400.	.028	
18 02 80 1000	0426	2800.	.024	
10 03 80 1140	0426	1210.	.041	.212
24 03 80 1400	0426			.237
08 04 80 1000	0426	470.	.049	.218
21 04 80 1000	0426	826.	.037	.148
05 05 80 0940	0426	725.	.026	.159
20 05 80 1000	0426	300.	.020	.005
02 06 80 0700	0426	751.	.034	.040
16 06 80 1000	0426	5.	.008	.001
01 07 80 1000	0426	428.	.006	.087
14 07 80 1130	0426	640.	.013	.194
28 07 80 1030	0426	524.	.018	.093
11 08 80 0950	0426	646.	.021	.108
25 08 80 1000	0426	664.	.023	.141
08 09 80 1000	0426	942.	.029	.142
22 09 80 1000	0426	942.	.008	.210
06 10 80 1000	0426	772.	.017	.025
20 10 80 1100	0426	765.	.013	.207
03 11 80 1400	0426	512.	.018	.165
18 11 80 1000	0426	669.	.027	.129
08 12 80 1130	0426	867.	.033	.211
05 01 81 1214	0426	659.	.019	.179
26 01 81 1230	0426	644.	.035	.214
16 02 81 1200	0426	779.	.004	.226

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                                                         NAQUADAT DETAILED REPORT
                                                    AGP PBAP AND DBAP

STATION 00AT05BM2161    LAT. 50D 53M 34S  LONG. 114D 27M  0S   PR 3   UTM 11 679350E 5640800N
BOW RIVER AT HIGHWAY 22X, CALGARY


                             54101L       54611L       54601L
                            FILTERED    PARTICULATE   DISSOLVED
                          ALGAL GROWTH BIOLOGICALLY BIOLOGICALLY
  SAMPLE DATE               POTENTIAL    AVAILABLE    AVAILABLE
     MST           SUBM SELENASTRUM    PHOSPHORUS   PHOSPHORUS
 D  M  Y  HR        ID    CELLS/ML        MG/L         MG/L

09 03 81 1015  0426      589.          .033          .309
20 03 81 1215  0426      888.          .050          .248
06 04 81 1430  0426      905.          .003          .297
21 04 81 1300  0426      784.          .021          .189
04 05 81 1230  0426     1016.          .036          .220

19 05 81 1450  0426      482.          .259          .042
09 06 81 1030  0426      418.          .221          .042
30 06 81 1400  0426      526.          .005          .027
20 07 81 1515             86.
24 08 81 1550            518.

21 09 81 1105            694.
15 10 81 1415           1308.



STATION 00AT05BM2215    LAT. 50D 49M 56S  LONG. 133D 24M 46S   PR 3   UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR          UPSTREAM OF HIGHWAY #24


                             54101L       54611L       54601L
                            FILTERED    PARTICULATE   DISSOLVED
                          ALGAL GROWTH BIOLOGICALLY BIOLOGICALLY
  SAMPLE DATE               POTENTIAL    AVAILABLE    AVAILABLE
     MST           SUBM SELENASTRUM    PHOSPHORUS   PHOSPHORUS
 D  M  Y  HR        ID    CELLS/ML        MG/L         MG/L

15 05 79 0945  0426      294.
29 05 79 0645  0426      390.
12 06 79 0725  0426      338.
26 06 79 0635  0426      380.          .011
09 07 79 0730  0426      323.          .004

23 07 79 0705  0426      286.
05 08 79 1040  0426      277.          .003
21 08 79 0830  0426      390.          .009
24 09 79 0645  0426      518.          .009
09 10 79 0645  0426      776.          .014

29 10 79 0800  0426     1237.          .020
19 11 79 0730  0426     1060.          .013
10 12 79 0800  0426     1030.          .022
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NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05BM2215 LAT. 50D 49M 56S LONG. 133D 24M 46S PR 3 UTM 08 611800E 5632150N
BOW RIVER BELOW CARSELAND WEIR UPSTREAM OF HIGHWAY #24

SAMPLE DATE MST D M Y HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
07 01 80 1130	0426	2440.	.030	
28 01 80 0830	0426	2540.	.014	
18 02 80 0830	0426	2570.	.025	
10 03 80 1000	0426	999.	.041	.211
24 03 80 0900	0426			.237
08 04 80 0830	0426	953.	.046	.203
21 04 80 0830	0426	587.	.028	.112
05 05 80 1320	0426	480.	.027	.112
21 05 80 0900	0426	402.	.018	.027
03 06 80 0830	0426	470.	.063	.113
16 06 80 1400	0426	266.	.019	.012
01 07 80 1230	0426	368.	.007	.039
14 07 80 0830	0426	433.	.017	.026
28 07 80 1245	0426	469.	.015	.108
11 08 80 1145	0426	393.	.020	.129
25 08 80 1230	0426	580.	.006	.113
08 09 80 1300	0426	541.	.004	.130
22 09 80 1220	0426	903.	.008	.141
06 10 80 1200	0426	491.	.006	.151
20 10 80 1245	0426	591.	.008	.134
03 11 80 1216	0426	558.	.009	.130
18 11 80 1120	0426	686.	.007	.119
08 12 80 0900	0426	979.	.007	.260
05 01 81 1100	0426	658.	.007	.179
26 01 81 1100	0426	906.	.013	.183
16 02 81 1000	0426	2246.	.013	.185
09 03 81 1130	0426	502.	.042	.198
20 03 81 1125	0426	988.	.028	.224
06 04 81 1145	0426	755.	.005	.110
21 04 81 1015	0426	1100.	.011	.185
04 05 81 1030	0426	902.	.020	.138
19 05 81 1150	0426	208.	.053	.024
09 06 81 1225	0426	309.	.013	.047
30 06 81 1000	0426	247.	.033	.069
20 07 81 1245		57.		
24 08 81 1400		299.		
21 09 81 0920		839.		
14 10 81 1750		1250.		

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                                                              AGP PBAP AND DBAP

STATION 00AT05BM2240    LAT. 50D 44M 52S  LONG. 112D 31M 27S   PR 3   UTM 12 392500E 5622650N
 BOW RIVER BELOW BASSANO DAM


                                 54101L       54611L        54601L
                                FILTERED    PARTICULATE    DISSOLVED
                              ALGAL GROWTH BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE                   POTENTIAL    AVAILABLE      AVAILABLE
      MST              SUBM   SELENASTRUM   PHOSPHORUS     PHOSPHORUS
  D  M  Y  HR           ID      CELLS/ML       MG/L           MG/L

 15 05 79 1300  0426       274.
 29 05 79 0945  0426       329.
 04 06 79 0845  0426       262.
 12 06 79 1015  0426       113.
 26 06 79 0950  0426        91.          .008

 04 07 79 0820  0426        44.          .009
 10 07 79 0750  0426       278.          .011
 24 07 79 0845  0426       183.
 30 07 79 1045  0426       169.          .002
 06 08 79 0810  0426       147.          .004

 21 08 79 1040  0426        38.          .010
 24 09 79 1020  0426       482.          .009
 09 10 79 1020  0426       853.          .012
 29 10 79 1100  0426       935.          .022
 19 11 79 1030  0426       872.          .014

 10 12 79 1200  0426      1200.          .011
 08 01 80 0930  0426      1990.          .024
 29 01 80 0830  0426      2210.          .027
 19 02 80 0840  0426      2224.          .024
 11 03 80 0830  0426       993.          .042           .183

 25 03 80 1415  0426                                    .194
 09 04 80 0830  0426      1010.          .081           .125
 22 04 80 0900  0426       592.          .055           .104
 05 05 80 1710  0426       271.          .012           .082
 21 05 80 1230  0426        59.          .005           .042

 03 06 80 1130  0426       451.          .027           .028
 17 06 80 0910  0426       284.          .026           .028
 02 07 80 0900  0426       327.          .007           .049
 15 07 80 0900  0426       363.          .012           .036
 29 07 80 1100  0426       263.          .018           .113

 12 08 80 0915  0426       261.          .012           .128
 26 08 80 1115  0426       374.          .010           .060
 09 09 80 1000  0426       199.          .009           .068
 23 09 80 1000  0426       501.          .006           .095
 07 10 80 1000  0426       218.          .010           .101

 21 10 80 1100  0426       555.          .052           .100
 04 11 80 1048  0426       462.          .023           .112
 18 11 80 1310  0426       815.          .031           .091
 09 12 80 0900  0426       999.          .008           .238
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REQUEST 0001 PAGE  17                                    NAQUADAT DETAILED REPORT
                                                    AGP PBAP AND DBAP

STATION 00AT05BM2240    LAT. 50D 44M 52S  LONG. 112D 31M 27S   PR 3   UTM 12 392500E 5622650N
 BOW RIVER BELOW BASSANO DAM


                            54101L        54611L        54601L
                           FILTERED     PARTICULATE    DISSOLVED
                         ALGAL GROWTH  BIOLOGICALLY  BIOLCGICALLY
  SAMPLE DATE              POTENTIAL     AVAILABLE      AVAILABLE
      MST           SUBM SELENASTRUM    PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR         ID    CELLS/ML        MG/L          MG/L

06 01 81 0900      0426      530.          .007          .176
27 01 81 1000      0426      900.          .025          .136
17 02 81 0900      0426     1212.          .020          .168
10 03 81 0800      0426      614.          .021          .177
21 03 81 1213      0426      648.          .037          .179

07 04 81 1100      0426      576.          .003          .125
22 04 81 0800      0426      454.          .014          .141
05 05 81 0800      0426     1304.          .046          .086
20 05 81 0900      0426      227.          .020          .012
07 06 81 1300      0426      213.          .025          .034

01 07 81 0820      0426       93.          .001          .001
21 07 81 1105                  2.
25 08 81 1035                182.
22 09 81 1055                391.
14 10 81 1100                903.



STATION 00AT05BN2245    LAT. 50D 25M 55S  LONG. 112D 13M 19S   PR 3   UTM 12 413200E 5587150N
BOW RIVER  AT BOW CITY BRIBGE


                            54101L        54611L        54601L
                           FILTERED     PARTICULATE    DISSOLVED
                         ALGAL GROWTH  BIOLOGICALLY  BIOLCGICALLY
  SAMPLE DATE              POTENTIAL     AVAILABLE      AVAILABLE
      MST           SUBM SELENASTRUM    PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR         ID    CELLS/ML        MG/L          MG/L

24 09 79 1310      0426       27.          .011
09 10 79 1400      0426       41.          .037
29 10 79 1400      0426      565.          .012
19 11 79 1230      0426      833.          .014
10 12 79 1330      0426     1390.          .013

08 01 80 1130      0426     1940.          .015
29 01 80 1040      0426     2260.          .022
19 02 80 1040      0426     2200.          .019
11 03 80 1030      0426     1240.          .041          .204
25 03 80 0915      0426                                 .190

09 04 80 1025      0426     1100.          .094          .122
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NAQUADAT DETAILED REPORT
AGP PBAP AND DBAP

STATION 00AT05BN2245 LAT. 50D 25M 55S LONG. 112D 13M 19S PR 3 UTM 12 413200E 5587150N
BOW RIVER AT BOW CITY BRIBGE

SAMPLE DATE MST D	M	Y	HR	SUBM ID	54101L FILTERED ALGAL GROWTH POTENTIAL SELENASTRUM CELLS/ML	54611L PARTICULATE BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L	54601L DISSOLVED BIOLOGICALLY AVAILABLE PHOSPHORUS MG/L
22	04	80	1130	0426	753.	.085	.082
06	05	80	1910	0426	91.	.012	.030
21	05	80	1600	0426	9.	.017	.015
03	06	80	1500	0426	393.		.031
17	06	80	1230	0426	280.	.035	.029
02	07	80	1230	0426	213.	.004	.031
15	07	80	1300	0426	9.	.004	.002
29	07	80	1310	0426	15.	.015	.008
12	08	80	1345	0426	46.	.015	.008
26	08	80	1315	0426	6.	.006	.001
09	09	80	1230	0426	3.	.003	.002
23	09	80	1145	0426	118.	.011	.014
07	10	80	1215	0426	57.	.010	.007
21	10	80	1330	0426	754.	.039	.120
04	11	80	1330	0426	576.	.032	.100
19	11	80	1200	0426	650.	.031	.076
09	12	80	1100	0426	1010.	.020	.168
06	01	81	1050	0426	547.	.007	.139
27	01	81	1200	0426	972.	.026	.162
17	02	81	1100	0426	1337.	.023	.166
10	03	81	1100	0426	1003.	.178	.173
21	03	81	1420	0426	768.	.032	.162
07	04	81	1330	0426	593.	.013	.072
22	04	81	1000	0426	366.	.009	.133
05	05	81	1045	0426	1041.	.028	.108
20	05	81	1130	0426	364.	.064	.025
07	06	81	1115	0426	172.	.024	.018
01	07	81	1030	0426	5.	.006	.002
21	07	81	1440		140.		
25	08	81	1500		177.		
22	09	81	1300		47.		

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REQUEST 0001 PAGE  19                                         NAQUADAT DETAILED REPORT
                                                           AGP PBAP AND DBAP

STATION 00AT05BN2270    LAT. 50D  2M 39S  LONG. 111D 34M 52S   PR 3   UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

                           54101L        54611L        54601L
                          FILTERED     PARTICULATE    DISSOLVED
                        ALGAL GROWTH BIOLOGICALLY  BIOLOGICALLY
   SAMPLE DATE            POTENTIAL    AVAILABLE     AVAILABLE
       MST          SUBM SELENASTRUM   PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR         ID    CELLS/ML       MG/L          MG/L

15 05 79 1635       0426       10.
29 05 79 1226       0426      270.
12 06 79 1305       0426      145.
26 06 79 1210       0426       83.        .013
10 07 79 1040       0426        8.        .003

24 07 79 1120       0426       20.
06 08 79 1110       0426        3.        .003
21 08 79 1315       0426        5.        .005
24 09 79 0930       0426       23.        .007
09 10 79 1630       0426       20.        .020

30 10 79 1030       0426       28.        .010
19 11 79 1430       0426      812.        .024
10 12 79 1500       0426     1380.        .012
08 01 80 1330       0426     1810.        .026
29 01 80 1245       0426     2110.        .021

19 02 80 1230       0426     1980.        .042
11 03 80 1245       0426     1250.        .046          .170
25 03 80 1050       0426                                .178
09 04 80 1250       0426      941.        .140          .102
22 04 80 1600       0426     1070.        .175          .105

06 05 80 1110       0426      153.        .032          .033
22 05 80 0830       0426       10.        .003          .005
04 06 80 0830       0426      346.        .068          .020
18 06 80 1045       0426      307.        .049          .027
03 07 80 0800       0426       50.        .015          .011

16 07 80 0945       0426        7.        .002          .007
30 07 80 1015       0426       19.        .003          .008
13 08 80 0900       0426       19.        .010          .005
27 08 80 0915       0426       18.        .008          .003
10 09 80 0830       0426       11.        .001          .001

24 09 80 0930       0426       12.        .009          .002
08 10 80 0830       0426       22.        .006          .003
22 10 80 0940       0426      614.        .054          .065
04 11 80 1630       0426      444.        .026          .087
19 11 80 0930       0426      839.        .023          .062

09 12 80 1430       0426     1020.        .006          .147
27 01 81 1405       0426     1104.        .001          .184
17 02 81 1500       0426     1234.        .027          .043
10 03 81 1400       0426      617.        .042          .170
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REQUEST 0001 PAGE  20                                       NAQUADAT DETAILED REPORT
                                                       AGP PBAP AND DBAP

STATION 00AT05BN2270    LAT. 50D  2M 39S  LONG. 111D 34M 52S   PR 3   UTM 12 458400E 5543500N
BOW RIVER AT RONALANE BRIDGE

                           54101L        54611L        54601L
                          FILTERED     PARTICULATE    DISSOLVED
                        ALGAL GROWTH  BIOLOGICALLY  BIOLOGICALLY
  SAMPLE DATE             POTENTIAL     AVAILABLE     AVAILABLE
     MST           SUBM  SELENASTRUM   PHOSPHORUS    PHOSPHORUS
 D  M  Y  HR        ID     CELLS/ML       MG/L          MG/L

22 03 81 0920     0426       894.          .024          .115
07 04 81 1530     0426       754.          .010          .116
22 04 81 1240     0426       261.          .003          .094
05 05 81 1245     0426        33.          .017          .028
20 05 81 1330     0426       366.          .066          .031

07 06 81 0915     0426       191.          .042          .017
01 07 81 1230     0426         2.          .022          .002
21 07 81 1630                 80.
25 08 81 1255                 18.
22 09 81 1615                 28.

14 10 81 1330                 10.
14 10 81 1535                 34.
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B-3 NAQUADAT printout of relevant Environment Canada data collected during the study period

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AL05BH0017 LAT. 51D 10M 25S LONG. 114D 28M 0S PR 5 UTM 11 677000E 5672000N
BOW RIVER AT COCHRANE, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSFHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103D PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07651L NITROGEN DISSOLVED N MG/L	07110D NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
09 05 79 0825	0479	L.003		L.003 03L		L.003 56L	.18	.01 10L	L.1
06 06 79 1540	0479	.008		L.003 03L		L.003 56L	.13	.03 10L	L.1
25 07 79 0740	0479	.006		L.003 03L		L.003 56L	.06	.03 10L	L.1
30 08 79 1100	0479	.014		L.003 03L			.08	.03 10L	L.1
12 09 79 0710	0479	L.003		L.003 03L			.07	.03 10L	L.1
11 10 79 0855	0479	.006		L.003 03L			.05	.01 10L	L.1
15 11 79 0830	0479	L.003		L.003 03L			.08	.04 10L	L.1
10 12 79 1045	0479	.003		L.003 03L			.15	.10 10L	L.1
16 01 80 1400	0479	.013		.009 03L			.15	.10 10L	L.1
06 02 80 0950	0479	L.003		L.003 03L			.15	.08 10L	L.1
05 03 80 0910	0479	L.003		L.003 03L			.12	.09 10L	L.1
23 04 80 1055	0479	.005					.13	.03 10F	
[illegible]	0479	.010		.007 03F			.14	.06 10F	
18 06 80 0915	0479	.019		.007 03F			.11	.06 10F	
29 07 80 1130	0479			L.003 03F			.10	.02 10F	
20 08 80 1015	0479	.004		L.003 03F			.05	.02 10F	
17 09 80 1015	0479	.003		L.003 03F			.10	.01 10F	
08 10 80 0815	0479	L.003		L.003 03F			.07	.02 10F	
12 11 80 1145	0479	L.003		L.003 03F			.07	.04 10F	
15 12 80 1135	0479	.004		.003 03F			.12	.07 10F	
14 01 81 1055	0479	.003		.003 03F			.10	.08 10F	L.1
25 02 81 1100	0479	L.003		L.003 03F			.07	.01 10F	L.1
25 03 81 1050	0479	L.003		L.003 03F			.06	.02 10F	L.1
23 04 81 1040	0479	.004		L.003 03F			.11	L.01 10F	L.1
12 05 81 0930	0479	.007		L.003 03F			.09	.04 10F	L.1
13 05 81 0930	0479	.007		L.003 03F			.09	.04 10F	
17 06 81 0945	0479	.007		L.003 03F			.12	.06 10F	L.1
08 07 81 0945	0479	.010		.003 03F			.07	.04 10F	
12 08 81 0900	0479	.004		L.003 03F			.09	.05 10F	
16 09 81 0945	0479	L.003		L.003 03F			.08	.04 10F	
07 10 81 0850	0479	.004		L.003 03F			.08	.03 10F	
04 11 81 0930	0479	.008		.003 03F			.09	.05 10F	
09 12 81 1010	0479	L.003		L.003 03F			.11	.08 10F	
13 01 82 1300	0479	L.003		L.003 03F			.12	.10 10F	L.1
29 03 82 1145	0479	.017		.008 03L			.27	.09 10L	L.1
26 04 82 0740	0479	.011		L.003 03F			.18	.06 10F	L.1

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AL05BH0017 LAT. 51D 10M 25S LONG. 114D 28M 0S PR 5 UTM 11 677000E 5672000N
BOW RIVER AT COCHRANE, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	02061F TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902L NITROGEN PARTICUL. N MG/L	06902L CARBON ORGANIC PARTICULATE C MG/L	06104L CARBON DISSOLVED ORGANIC C MG/L
09 05 79 0825	0479	5. 61S	1.3	2.		.04	.22	4.
06 06 79 1540	0479	11.0 61S	3.2	5.		.08	.26	2.
25 07 79 0740	0479	13.5 61S	2.4	21.		.06	.23	1.
30 08 79 1100	0479	16. 61S	3.4	L1.		.02	.16	1.
12 09 79 0710	0479	10. 61S	2.1	L1.		.03	.12	L1.
11 10 79 0855	0479	8. 61S	.5	1.		.04	.18	L1.
15 11 79 0830	0479	1.5 61S	.2	L1.		.03	.15	1.
10 12 79 1045	0479	.5 61S	1.5	L1.		.04	.12	1.
16 01 80 1400	0479	1.5	1.0	L1.		.04	.17	1.
06 02 80 0950	0479	1.5	2.5	L1.		.03	.12	1.
05 03 80 0910	0479	1.5	.9	3.		.04	.07	L1.
23 04 80 1055	0479	6.5	.2	1.		.09		2. 04F
14 05 80 0915	0479	10.0	4.5	6.		.14		2. 04F
18 06 80 0915	0479	11.0	11.0	11.		.10	.59	1. 04F
29 07 80 1130	0479	16.0	2.2	2.		.04	.24	L1. 04F
20 08 80 1015	0479	13.0	1.2	3.		.06	.23	1. 04F
17 09 80 1015	0479	8.0	1.2	4.		.01	.10	
08 10 80 0815	0479	7.5	.6	L1.		.09	.15	L1. 04F
12 11 80 1145	0479	.5	1.6	L1.		.04	.12	L1. 04F
15 12 80 1135	0479	2.0	2.1	5.	4.	.05	.24	L1. 04F
14 01 81 1055	0479	.0	2.0	1.		.04	.14	L1. 04F
25 02 81 1100	0479	.0	2.0	2.		.09	.26	L1. 04F
25 03 81 1050	0479	1.5	1.0	L1.		.05	.18	1.
23 04 81 1040	0479	7.	1.2	2.		L.01	.21	
12 05 81 0930	0479	7.0	5.0	6.		.05	.44	2.
13 05 81 0930	0479	7.0	5.0	6.		.05	.44	2.
17 06 81 0945	0479	9.5	5.5	7.		.04	.36	2.
08 07 81 0945	0479	12.0	4.8	7.		.05	.36	1.
12 08 81 0900	0479	14.0	2.7	1.		.04	.18	1.
16 09 81 0945	0479	12.0	1.3	L1.		L.01	.21	1.
07 10 81 0850	0479	6.0	.7	L1.		L.01	.16	1.
04 11 81 0930	0479	3.0	2.2	1.		L.01	.24	1.
09 12 81 1010	0479	.0	.9	L1.		L.01	.09	2.
13 01 82 1300	0479	1.0	1.1	L1.		L.01	.10	1.
29 03 82 1145	0479	2.0	1.0	2.		.06	.31	4.
26 04 82 0740	0479	.5	2.0	3.		.06	.35	3.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AL05BH0017 LAT. 51D 10M 25S LONG. 114D 28M 0S PR 5 UTM 11 677000E 5672000N
BOW RIVER AT COCHRANE, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
09 05 79 0825	0479	8.2	41. 52L	148. 06L		406.	3.0	4.0
06 06 79 1540	0479	8.3	32. 52L	117. 06L	.0	306.	1.1	4.5
25 07 79 0740	0479	8.2	22. 52L	91. 06L	.0	227.	.7	3.0
30 08 79 1100	0479	8.4	24. 52L	100. 06L	1.4	284.	.7	3.4
12 09 79 0710	0479	8.1	23. 52L	101. 06L	.0	286.	.8	2.9
11 10 79 0855	0479	8.3	26. 52L	120. 06L	.0	320.	.9	2.7
15 11 79 0830	0479	8.0	28. 52L	120. 06L	.0	338.	1.1	3.3
10 12 79 1045	0479	8.1	32. 52L		.0	390.	1.4	3.8
16 01 80 1400	0479	8.0	26. 52L	114. 06L	.0	358.	1.3	4.0
06 02 80 0950	0479	7.8	28. 52L	135. 06L	.0	370.	1.2	3.6
05 03 80 0910	0479	8.2	25. 52L	138. 06L	.0	405.	1.3	4.2
23 04 80 1055	0479	8.5		130.	.3	345.	1.4	3.7
14 05 80 0915	0479	8.3		102.	.0	268.	.8	3.4
18 06 80 0915	0479	8.2		103.	.0	269.	.7	3.6
29 07 80 1130	0479	8.4		105.	1.7	277.	.9	3.0
20 08 80 1015	0479	8.4		111.	.0	291.	.8	3.6
17 09 80 1015	0479	8.3		115.	.0	311.	1.0	3.4
08 10 80 0815	0479	8.3		122.	.0	322.	1.0	3.2
12 11 80 1145	0479	8.3		125.	.0	335.	1.1	3.2
15 12 80 1135	0479	8.3		130.	.0	353.	1.0	3.9
14 01 81 1055	0479	8.3		124.	.0	339.	1.0	3.8
25 02 81 1100	0479	8.3		125.	.0	348.	1.2	3.2
25 03 81 1050	0479	8.4		121.	.0	339.	.9	3.2
23 04 81 1040	0479	8.5		124.	3.	344.	1.2	2.9
12 05 81 0930	0479	8.2		129.	.0	335.	1.3	4.3
13 05 81 0930	0479	8.2		129.	.0	335.	1.3	4.3
17 06 81 0945	0479	8.3		118.	.0	298.	1.1	4.4
08 07 81 0945	0479	8.4		109.	.0	271.	.9	3.6
12 08 81 0900	0479	8.3		110.	.0	275.	.9	3.6
16 09 81 0945	0479	8.4		116.	.2	294.	.9	3.0
07 10 81 0850	0479	8.3		131.	.0	328.	1.2	3.0
04 11 81 0930	0479	8.2		136.	.0	347.	3.4	3.2
09 12 81 1010	0479	8.2		143.	.0	346.	1.5	3.8
13 01 82 1300	0479	8.2		137.	.0	341.	1.3	5.0
29 03 82 1145	0479	8.2		130.	.0	318.	1.5	3.8
26 04 82 0740	0479	8.1		135.	.0	321.	2.6	4.0

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AL05BN0001   LAT. 50D 2M 48S LONG. 111D 35M 27S   PR 4   UTM 12 457700E 5543700N
BOW RIVER NEAR MOUTH, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103D PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07651L NITROGEN DISSOLVED N MG/L	07110D NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
14 05 79 1200	0479	.038		.038 03L		.011 56L	.31	.08 10L	L.1
04 06 79 1110	0479	.082		.051 03L		.036 56L	.39	.20 10L	L.1
16 07 79 1100	0479	.036		.028 03L		.005 56L	.22	.01 10L	L.1
27 08 79 1100	0479	.043		.023 03L			.31	L.01 10L	L.1
17 09 79 1155	0479	.026		.014 03L			.26	L.01 10L	L.1
22 10 79 1215	0479	.033		.011 03L			.73	.47 10L	L.1
19 11 79 1250	0479	.13		.089 03L			1.7	1.1 10L	L.1
11 12 79 1220	0479	.16		.14 03L			2.4	1.5 10L	.7
21 01 80 1320	0479	.16		.16 03L			1.8	1.2 10L	.6
18 02 80 1320	0479	.15		.12 03L			2.2	1.3 10L	.2
17 03 80 1410	0479	.23		.20 03L			1.9	1.4 10L	.4
14 04 80 1545	0479	.400		.095 03F			1.30	.85 10F	
12 05 80 1700	0479	.091		.035 03F			.29	.28 10F	
09 06 80 1340	0479	.180		.034 03F			.51	.35 10F	
14 07 80 1245	0479	.020		.013 03F			.27	L.01 10F	
05 08 80 1240	0479	.025		.008 03F			.24	L.01 10F	
15 09 80 1215	0479	.021		.008 03F			.30	L.01 10F	
20 10 80 1320	0479	.150		.056 03F			1.20	.88 10F	
25 11 80 1330	0479	.130		.120 03F			1.20	.96 10F	
08 12 80 1345	0479	.180		.170 03F			1.90	1.30 10F	
19 01 81 1330	0479	.170		.150 03F			1.20	.92 10F	.6
16 02 81 1330	0479	.190		.150 03F			2.30	2.00 10F	.4
09 03 81 1315	0479	.170		.120 03F			1.30	1.10 10F	.1
07 04 81 1245	0479	.19		.11 03F			2.1 51F	.70 10F	.2
11 05 81 1320	0479	.088		.046 03F			.54	.46 10F	L.1
01 06 81 1650	0479	.29		.021 03F			.52	.26 10F	L.1
01 07 81 1415	0479	.037		.005 03F			.16	.05 10F	
17 08 81 1300	0479	.044		.015 03F			.23	.09 10F	
21 09 81 1200	0479	.024		.012 03F			.18	L.01 10F	
19 10 81 1215	0479	.038		.008 03L			.28	.02 10L	
16 11 81 1400	0479	.230		.110 03F			1.30	1.40 10F	
15 12 81 1515	0479	.120		.110 03F			1.70	1.20 10F	
25 01 82 1415	0479	.180		.170 03F			2.00	1.30 10F	L.1
16 02 82 1420	0479	.220		.220 03F			1.90	.66 10F	L.1
22 03 82 1345	0479	.250		.230 03F			1.80	1.70 10F	.6
26 04 82 1330	0479	.320		.062 03F			1.00	.80 10F	.4

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AL05BN0001 LAT. 50D 2M 48S LONG. 111D 35M 27S PR 4 UTM 12 457700E 5543700N
BOW RIVER NEAR MOUTH, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	02061F TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902L NITROGEN PARTICUL. N MG/L	06902L CARBON ORGANIC PARTICULATE C MG/L	06104L CARBON DISSOLVED ORGANIC C MG/L
14 05 79 1200	0479	15.5 61S	3.0	21.		.10	.40	3.
04 06 79 1110	0479	18.5 61S	6.0	7.		.12	.58	3.
16 07 79 1100	0479	20.5 61S	4.2	4.		.13	.26	3.
27 08 79 1100	0479	21.5 61S	2.7	1.5		.08	.24	4.
17 09 79 1155	0479	16. 61S	2.8	2.		.03	.12	2.
22 10 79 1215	0479	4.5 61S	3.0	10.		.15	.74	1.
19 11 79 1250	0479	2.5 61S	6.0	4.		.08	.66	2.
11 12 79 1220	0479	1.0 61S	3.5	2.		.06	.30	2.
21 01 80 1320	0479	1.0	4.0	9.		.05	.22	2.
18 02 80 1320	0479	.5	2.6	5.		.10	.56	1.
17 03 80 1410	0479	1.5	7.7	10.		.11	.69	2.
14 04 80 1545	0479	8.5	43.0	213.		1.00		3. 04F
12 05 80 1700	0479	15.0	21.0	34.		.26		3. 04F
09 06 80 1340	0479	17.5	58.0	137.		.42	3.70	4. 04F
14 07 80 1245	0479	22.0	2.9	6.		.07	.27	3. 04F
05 08 80 1240	0479	19.0	5.5	10.		.10	.78	3. 04F
15 09 80 1215	0479	11.0	3.6	6.		.14	.47	4. 04F
20 10 80 1320	0479	8.0	28.0	62.		.37	3.00	2. 04F
25 11 80 1330	0479	1.5	4.1	6.		.09	.35	2. 04F
08 12 80 1345	0479	.0	1.7	1.		.05	.26	2. 04F
19 01 81 1330	0479	1.0	5.1	11.		.14	.46	1. 04F
16 02 81 1330	0479	1.0	4.7	11.		.10	.71	2. 04F
09 03 81 1315	0479	3.2	6.7	21.		.17	1.50	2. 04F
07 04 81 1245	0479	6.5	20.	41.		.30	2.0	2.
11 05 81 1320	0479	12.	3.8	4.		.22	1.2	3.
01 06 81 1650	0479	15.	110.	253.		.53	7.8	3.
01 07 81 1415	0479	18.0	9.6	31.		.19	1.40	3.
17 08 81 1300	0479	23.0	5.8	15.		.14	.78	2.
21 09 81 1200	0479	13.0	2.4	4.		.07	.41	3.
19 10 81 1215	0479	8.5	4.8	7.		.25	1.40	3.
16 11 81 1400	0479	1.5	17.0	35.		.19	1.50	2.
15 12 81 1515	0479	.0	1.5	2.		L.01	.13	2.
25 01 82 1415	0479	1.0	1.9	3.		.03	.30	2.
16 02 82 1420	0479	2.0	4.1	7.		.05	.45	2.
22 03 82 1345	0479	2.5	2.7	6.		.09	.51	3.
26 04 82 1330	0479	9.0	270.0	334.		.67	6.30	3.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AL05BN0001 LAT. 50D 2M 48S LONG. 111D 35M 27S PR 4 UTM 12 457700E 5543700N
BOW RIVER NEAR MOUTH, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
14 05 79 1200	0479	7.9	31. 52L	111. 06L	.0	376.	5.3	L.1
04 06 79 1110	0479	8.6	30. 52L	109. 06L		350.	2.7	.9
16 07 79 1100	0479	9.3	19. 52L	70. 06L	45.	308.	3.2	1.6
27 08 79 1100	0479	9.1	24. 52L	102. 06L	.9	351.	4.8	.6
17 09 79 1155	0479	8.6	24. 52L	106. 06L	1.0	365.	4.9	.2
22 10 79 1215	0479	8.3	28. 52L	130. 06L	.0	449.	6.6	.4
19 11 79 1250	0479	8.2	32. 52L	130. 06L	.0	424.	6.5	1.0
11 12 79 1220	0479	8.1	35. 52L	136. 06L	.0	503.	8.7	1.8
21 01 80 1320	0479	7.7	31. 52L	125. 06L	.0	494.	7.9	3.3
18 02 80 1320	0479	7.9	23. 52L	120. 06L	.0	471.	7.9	1.8
17 03 80 1410	0479	7.8	26. 52L	122. 06L	.0	466.	8.2	3.8
14 04 80 1545	0479	7.5		110.	.0	382.	5.2	4.2
12 05 80 1700	0479	8.9		128.	8.1	343.	3.4	.5
09 06 80 1340	0479	8.2		118.	.0	332.	1.9	5.0
14 07 80 1245	0479	8.8		102.	9.2	374.	3.7	.5
05 08 80 1240	0479	8.8		104.	9.3	358.	3.8	.6
15 09 80 1215	0479	8.5		108.	.2	397.	4.9	1.1
20 10 80 1320	0479	8.2		134.	.0	405.	5.0	2.0
25 11 80 1330	0479	8.0		145.	.0	443.	6.4	1.6
08 12 80 1345	0479	8.0		177.	.0	529.	8.8	2.8
19 01 81 1330	0479	7.9		141.	.0	420.	5.2	4.2
16 02 81 1330	0479	7.9		143.	.0	430.	5.3	4.0
09 03 81 1315	0479	8.3		129.	.0	408.	6.0	2.1
07 04 81 1245	0479	8.2		135.	.0	417.	5.1	1.8
11 05 81 1320	0479	8.8		139.	9.	436.	6.0	.3
01 06 81 1650	0479	8.0		120.	.0	306.	1.7	5.0
01 07 81 1415	0479	8.8		122.	1.5	318.	3.0	1.3
17 08 81 1300	0479	8.8		118.	7.8	306.	2.4	.8
21 09 81 1200	0479	8.8		103.	5.8	325.	4.5	.4
19 10 81 1215	0479	8.4		135.	.2	430.	5.5	L.1
16 11 81 1400	0479	8.2		141.	.0	417.	5.9	.2
15 12 81 1515	0479	8.1		168.	.0	442.	7.3	2.1
25 01 82 1415	0479	7.5		164.	.0	442.	6.2	4.9
16 02 82 1420	0479	7.5		160.	.0	422.	6.4	4.8
22 03 82 1345	0479	7.5		140.	.0	413.	10.0	4.2
26 04 82 1330	0479	7.9		120.	.0	336.	6.2	2.9

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AL05AD0002 LAT. 49D 42M 30S LONG. 112D 52M 30S PR 4 UTM 12 364800E 5507700N
OLDMAN RIVER NEAR LETHBRIDGE, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSFHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103D PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07651L NITROGEN DISSOLVED N MG/L	07110D NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
15 05 79 1140	0479	.13				.005 56L	.22	.03 10L	L.1
05 06 79 1135	0479	.21		L.003 03L		L.003 56L	.22	.09 10L	L.1
17 07 79 1015	0479	.021		.003 03L		L.003 56L	.15	L.01 10L	L.1
28 08 79 1145	0479	.070		.012 03L			.18	.02 10L	L.1
18 09 79 1135	0479	.016		L.003 03L			.20	.07 10L	L.1
23 10 79 1200	0479	.015		L.003 03L			.14	.03 10L	L.1
20 11 79 1310	0479	.006		.003 03L			.14	.05 10L	L.1
12 12 79 1230	0479	.003		L.003 03L			.26	.16 10L	L.1
22 01 80 1345	0479	.007		.006 03L			.35	.29 10L	L.1
19 02 80 1430	0479	.005		L.003 03L			.32	.23 10L	L.1
19 03 80 1330	0479	.030		.025 03L			.43	.15 10L	L.1
15 04 80 1715	0479	.031		.010 03F			.21	L.01 10F	
13 05 80 1300	0479	.026		.003 03F			.33	.03 10F	
10 06 80 1110	0479	.058		L.003 03F			.14	.05 10F	
15 07 80 1130	0479	.010		.003 03F			.13	L.01 10F	
06 08 80 1330	0479	.031		.021 03F			.15	.02 10F	
16 09 80 1315	0479	.019		L.003 03F			.13	L.01 10F	
21 10 80 1330	0479	.051		.019 03F			.16	.03 10F	
26 11 80 1445	0479	.024		L.003 03F			.36	.08 10F	
09 12 80 1420	0479	.004		.004 03F			.21	.15 10F	
20 01 81 1430	0479	.034		.006 03F			.18	.12 10F	L.1
17 02 81 1530	0479	.044		L.003 03F			.23	.14 10F	L.1
10 03 81 1730	0479	.005		L.003 03F			.11	.03 10F	L.1
08 04 81 1415	0479	.011		L.003 03F			.14	L.01 10F	L.1
13 05 81 0630	0479	.085		.007 03F			.20	.06 10F	L.1
02 06 81 1500	0479	.16		.003 03F			.24	.11 10F	L.1
02 07 81 1400	0479	.036		.007 03F			.12	.02 10F	
18 08 81 1415	0479	.017		.006 03F			.13	L.01 10F	
22 09 81 1249	0479	.009		.006 03L			.14	L.01 10L	
21 10 81 0630	0479	.008		L.003 03F			.13	.02 10F	
17 11 81 1545	0479	.043		.010 03F			.15	.05 10F	
06 12 81 1515	0479	L.003		L.003 03F			.26	.20 10F	
26 01 82 1500	0479	.011		.004 03F			.42	.27 10F	L.1
17 02 82 1530	0479	.020		.010 03F			.41	.34 10F	L.1
23 03 82 1500	0479	.050		.011 03F			.31	.21 10F	L.1
27 04 82 1415	0479	.037		.003 03F			.20	L.01 10F	L.1

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AL05AD0002 LAT. 49D 42M 30S LONG. 112D 52M 30S PR 4 UTM 12 364800E 5507700N
OLDMAN RIVER NEAR LETHBRIDGE, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	02061F TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902L NITROGEN PARTICUL. N MG/L	06902L CARBON ORGANIC PARTICULATE C MG/L	06104L CARBON DISSOLVED ORGANIC C MG/L
15 05 79 1140	0479	14. 61S	88.	234.		.49	.54	3.
05 06 79 1135	0479	15. 61S	58.	42.		.49	4.6	2.
17 07 79 1015	0479	21.5 61S	4.7	7.		.12	.29	2.
28 08 79 1145	0479	21. 61S	39.	23.8		.06	.19	2.
18 09 79 1135	0479	17. 61S	5.4	2.		.08	.51	2.
23 10 79 1200	0479	5. 61S	1.5	10.		.05	.38	L1.
20 11 79 1310	0479	1.5 61S	3.5	4.				2.
12 12 79 1230	0479	1.0 61S	2.2	10.		.05	.16	2.
22 01 80 1345	0479	1.0	4.5	2.		.03	.12	2.
19 02 80 1430	0479	.5	3.8	3.		.04	.14	1.
19 03 80 1330	0479	.8	17.	9.		.07	.43	4.
15 04 80 1715	0479	10.5	2.2	13.		.15		4. 04F
13 05 80 1300	0479	13.0	12.0	27.		.16		3. 04F
10 06 80 1110	0479	17.0	28.0			.21	2.20	2. 04F
15 07 80 1130	0479	19.0	3.4	4.		.08	.44	2. 04F
06 08 80 1330	0479	18.0	6.5	12.		.09	.69	2. 04F
16 09 80 1315	0479	12.0	11.0	22.		.08	.65	1. 04F
21 10 80 1330	0479	6.0	14.0	43.		.16	2.70	2. 04F
26 11 80 1445	0479	1.0	20.0	27.		.13	.87	1. 04F
09 12 80 1420	0479	.3	4.1	6.		L.01	.23	1. 04F
20 01 81 1430	0479	2.0	20.0	57.		.12	1.20	1. 04F
17 02 81 1530	0479	1.0	15.0	25.		.06	.67	2. 04F
10 03 81 1730	0479	5.5	3.0	12.		.06	.28	2. 04F
08 04 81 1415	0479	6.	3.7	4.		L.01	.43	2.
13 05 81 0630	0479	9.0	60.	125.		.24	2.5	3.
02 06 81 1500	0479	14.	90.0	248.		.30	4.4	3.
02 07 81 1400	0479	18.0		41.		.09	.90	2.
18 08 81 1415	0479	22.0	2.7	4.		.04	.26	2.
22 09 81 1249	0479	12.0	3.6	4.		.04	.34	2.
21 10 81 0630	0479	4.0	3.3	3.		.05	.30	2.
17 11 81 1545	0479	.5	6.8	14.		.08	.83	3.
06 12 81 1515	0479	.0	2.5	3.		L.01	.13	2.
26 01 82 1500	0479	2.0	4.5	5.		.02	.18	2.
17 02 82 1530	0479	3.0	3.1	6.		.01	.31	2.
23 03 82 1500	0479	2.0	31.0	30.		.14	2.20	3.
27 04 82 1415	0479	12.0	28.0	33.		.15	.92	4.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AL05AD0002 LAT. 49D 42M 30S LONG. 112D 52M 30S PR 4 UTM 12 364800E 5507700N
OLDMAN RIVER NEAR LETHBRIDGE, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
15 05 79 1140	0479	8.3	33. 52L	127. 06L	.0	346.	1.3	4.4
05 06 79 1135	0479	8.1	28. 52L	98. 06L	.0	243.	.8	3.6
17 07 79 1015	0479	8.4	28. 52L	124. 06L		376.	1.5	1.9
28 08 79 1145	0479	8.5	28. 52L	123. 06L	2.0	405.	3.1	2.1
18 09 79 1135	0479	8.4	30. 52L	134. 06L		438.	2.1	.6
23 10 79 1200	0479	8.3	31. 52L	150. 06L	.0	446.	2.3	1.8
20 11 79 1310	0479	8.2	39. 52L	159. 06L	.0	484.	2.1	1.9
12 12 79 1230	0479	8.2	39. 52L	134. 06L	0.	499.	2.3	2.4
22 01 80 1345	0479	7.9	41. 52L	150. 06L	.0	509.	2.2	3.2
19 02 80 1430	0479	7.9	28. 52L	134. 06L	.0	501.	2.1	2.5
19 03 80 1330	0479	8.2	26. 52L	116. 06L	.0	446.	2.6	2.4
15 04 80 1715	0479	8.4		160.	1.5	582.	3.4	.3
13 05 80 1300	0479	8.4		115.	2.0	292.	.9	3.0
10 06 80 1110	0479	8.3		111.	.0	272.	.8	3.8
15 07 80 1130	0479	8.5		127.	3.9	352.	1.2	2.0
06 08 80 1330	0479	8.5		119.	4.0	325.	6.0	2.0
16 09 80 1315	0479	8.4		136.	2.6	396.	1.8	2.0
21 10 80 1330	0479	8.3		140.	.0	395.	2.0	1.7
26 11 80 1445	0479	8.0		145.	.0	382.	1.4	2.3
09 12 80 1420	0479	8.1		169.	.0	460.	1.7	3.4
20 01 81 1430	0479	8.3		142.	.0	368.	1.3	3.5
17 02 81 1530	0479	8.2		143.	.0	410.	1.7	3.1
10 03 81 1730	0479	8.4		153.	6.9	409.	1.9	1.8
08 04 81 1415	0479	8.4		172.	.0	484.	2.0	2.7
13 05 81 0630	0479	8.3		133.	.0	324.	1.1	4.9
02 06 81 1500	0479	8.2		113.	.0	275.	.8	4.8
02 07 81 1400	0479	8.4		123.	.0	292.	1.0	3.3
18 08 81 1415	0479	8.6		139.	2.6	362.	1.4	2.8
22 09 81 1249	0479	8.4		147.	.2	442.	2.2	1.2
21 10 81 0630	0479	8.2		160.	.0	447.	2.4	1.0
17 11 81 1545	0479	8.2		150.	.0	401.	1.7	1.8
06 12 81 1515	0479	8.1		196.	.0	503.	2.3	3.0
26 01 82 1500	0479	7.7		180.	.0	455.	2.0	4.2
17 02 82 1530	0479	7.9		165.	.0	417.	3.1	3.6
23 03 82 1500	0479	8.1		160.	.0	428.	3.7	2.8
27 04 82 1415	0479	8.3		145.	.0	372.	2.2	1.9

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AL05AG0001 LAT. 49D 57M 40S LONG. 112D 5M 5S PR 5 UTM 12 422200E 5534600N
OLDMAN RIVER AT HWY 36 NORTH OF TABER, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103D PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07651L NITROGEN DISSOLVED N MG/L	07110D NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L
14 05 79 1000	0479	.14		.005 03L		L.003 56L	.23	.07 10L	.1
04 06 79 0945	0479	.14		.006 03L		.004 56L	.24	.08 10L	L.1
16 07 79 0940	0479	.024		.12 03L		L.003 56L	.15	.01 10L	L.1
27 08 79 0950	0479	.095		.036 03L			.32	.09 10L	L.1
17 09 79 0950	0479	.030		.016 03L			.24	L.01 10L	L.1
22 10 79 1050	0479	.065		.055 03L			.48	.14 10L	.2
19 11 79 1135	0479	.059		.057 03L			.38	.14 10L	L.1
11 12 79 1100	0479	.11		.090 03L			.79	.31 10L	.3
21 01 80 1200	0479	.20		.18 03L			1.1	.58 10L	.4
18 02 80 1210	0479	.19		.17 03L			.86	.44 10L	.3
17 03 80 1245	0479	.13		.11 03L			.80		.2
14 04 80 1400	0479	.150		.100 03F			.28	.02 10F	
12 05 80 1210	0479	.110		.021 03F			.17	.13 10F	
09 06 80 1200	0479	.092		.010 03F			.15	.07 10F	
14 07 80 1100	0479	.038		.026 03F			.15	L.01 10F	
05 08 80 1040	0479	.071		.044 03F			.24	L.01 10F	
15 09 80 1010	0479	.050		.031 03F			.20	L.01 10F	
20 10 80 1030	0479	.039		.024 03F			.16	L.01 10F	
25 11 80 1140	0479	.038		.010 03F			.22	.12 10F	
08 12 80 1115	0479	.015		.006 03F			.55	.26 10F	
19 01 81 1115	0479	.074		.069 03F			.35	.15 10F	.2
16 02 81 1130	0479	.070		.051 03F			.50	.25 10F	.1
09 03 81 1130	0479	.072		.040 03F			.15	.06 10F	L.1
07 04 81 1100	0479	.085		.047 03F			.19	L.01 10F	L.1
11 05 81 1115	0479	.46		.011 03F			.25	.17 10F	.1
01 06 81 1430	0479	.29		.008 03F			.24	.12 10F	L.1
01 07 81 1100	0479	.045		.004 03L			.10	L.01 10L	
17 08 81 1045	0479	.020		.010 03F			.18	.01 10F	
21 09 81 1015	0479	.037		.022 03F			.21	L.01 10F	
19 10 81 1015	0479	.078		.055 03F			.19	.02 10F	
16 11 81 1200	0479	.099		.057 03F			.15	.03 10F	
15 12 81 1310	0479	.063		.055 03F			.44	.25 10F	
25 01 82 1215	0479	.300		.280 03F			1.30	.49 10F	L.1
16 02 82 1245	0479	.250		.240 03F			1.00	.58 10F	L.1
22 03 82 1200	0479	.110		.095 03F			.52	.30 10F	.1
26 04 82 1130	0479	.120		.039 03F			.23	.05 10F	L.1

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AL05AG0001 LAT. 49D 57M 40S LONG. 112D 5M 5S PR 5 UTM 12 422200E 5534600N
OLDMAN RIVER AT HWY 36 NORTH OF TABER, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	02061F TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902L NITROGEN PARTICUL. N MG/L	06902L CARBON ORGANIC PARTICULATE C MG/L	06104L CARBON DISSOLVED ORGANIC C MG/L
14 05 79 1000	0479	13.5 61S	73.	148.		.36	3.9	3.
04 06 79 0945	0479	17.5 61S	81.	207.		.34	3.6	3.
16 07 79 0940	0479	19.5 61S	6.2	5.		.47	.48	3.
27 08 79 0950	0479	20. 61S	28.	11.8		.10	.48	3.
17 09 79 0950	0479	16. 61S	2.4	1.		.08	.35	2.
22 10 79 1050	0479	4.5 61S	1.5	1.		.06	.32	1.
19 11 79 1135	0479	2. 61S	2.5	L1.		.05	.26	2.
11 12 79 1100	0479	1.0 61S	5.0	2.		.07	.28	2.
21 01 80 1200	0479	1.0	3.5	6.		L.01	.33	3.
18 02 80 1210	0479	.5	2.7	2.		.08	.40	2.
17 03 80 1245	0479	1.5	5.9	6.		.13	.60	4.
14 04 80 1400	0479	14.0	13.0	15.		L.01		3. 04F
12 05 80 1210	0479	15.0	56.0	109.		.34		2.
09 06 80 1200	0479	17.0	46.0	105.		.27	2.70	2. 04F
14 07 80 1100	0479	20.0	5.0	7.		.11	.52	2. 04F
05 08 80 1040	0479	16.0	10.0	16.		.16	1.10	3. 04F
15 09 80 1010	0479	11.0	5.8	7.		.16	.70	3. 04F
20 10 80 1030	0479	8.0	4.4	6.		.08	.48	2. 04F
25 11 80 1140	0479	1.5	8.5	L1.		.21	1.00	2. 04F
08 12 80 1115	0479	.0	1.7	1.		.06	.26	2. 04F
19 01 81 1115	0479	1.5	4.2	8.		.17	.55	2. 04F
16 02 81 1130	0479	.5	3.4	5.		.11	.56	4. 04F
09 03 81 1130	0479	4.0	6.9	6.		.14	.74	2. 04F
07 04 81 1100	0479	5.5	3.6	7.		.18	.78	3.
11 05 81 1115	0479	10.	220.	579.		1.0	10.9	3.
01 06 81 1430	0479	16.	140.	379.		.45	7.5	3.
01 07 81 1100	0479	18.0	29.0	65.		.13	1.20	2.
17 08 81 1045	0479	22.0	4.3	7.		.09	.46	2.
21 09 81 1015	0479	13.0	4.4	5.				2.
19 10 81 1015	0479	8.0	5.5	6.		.08	.49	3.
16 11 81 1200	0479	3.0	5.0	8.		.11	.67	2.
15 12 81 1310	0479	.0	2.0	1.		L.01	.18	2.
25 01 82 1215	0479	1.0	1.3	1.		.07	.39	2.
16 02 82 1245	0479	2.0	1.6	L1.		L.01	.30	2.
22 03 82 1200	0479	2.0	2.5	4.		.10	.47	4.
26 04 82 1130	0479	11.5	18.0	40.		.34	1.90	4.

NAQUADAT DETAILED REPORT
PH DIC ALK COND CL SIO2

STATION 00AL05AG0001 LAT. 49D 57M 40S LONG. 112D 5M 5S PR 5 UTM 12 422200E 5534600N
OLDMAN RIVER AT HWY 36 NORTH OF TABER, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
14 05 79 1000	0479	8.2	35. 52L	136. 06L	.0	330.	1.8	4.
04 06 79 0945	0479	8.1	29. 52L	107. 06L	.0	283.	1.0	3.6
16 07 79 0940	0479	8.6	31. 52L	116. 06L	23.	380.	4.6	1.5
27 08 79 0950	0479	8.3	26. 52L	108. 06L	.0	431.	10.	2.1
17 09 79 0950	0479	8.5	30. 52L	133. 06L	3.0	492.	12.	.2
22 10 79 1050	0479	8.3	28. 52L	130. 06L	.0	420.	6.0	.2
19 11 79 1135	0479	8.2	39. 52L	159. 06L	.0	518.	7.3	.2
11 12 79 1100	0479	8.2	43. 52L		.0	576.	9.7	.8
21 01 80 1200	0479	7.8	43. 52L	175. 06L	.0	638.	12.	1.3
18 02 80 1210	0479	7.7	31. 52L	160. 06L	.0	577.	11.	.5
17 03 80 1245	0479	7.9	30. 52L	136. 06L	.0	544.	6.2	2.6
14 04 80 1400	0479	8.7		170.	7.1	535.	7.4	.1
12 05 80 1210	0479	8.2		114.	.0	280.	1.2	3.5
09 06 80 1200	0479	8.4		110.	3.4	284.	1.0	3.8
14 07 80 1100	0479	8.7		125.	8.9	378.	4.6	.6
05 08 80 1040	0479	8.6		129.	1.3	444.	7.9	.5
15 09 80 1010	0479	8.6		130.	2.1	425.	5.9	.6
20 10 80 1030	0479	8.6		143.	4.1	435.	6.7	.2
25 11 80 1140	0479	8.3		144.	.0	399.	4.7	1.0
08 12 80 1115	0479	8.0		185.	.0	521.	4.0	.6
19 01 81 1115	0479	8.1		150.	.0	409.	5.3	3.3
16 02 81 1130	0479	7.9		168.	.0	521.	8.4	1.6
09 03 81 1130	0479	8.6		155.	2.5	457.	4.5	.2
07 04 81 1100	0479	8.4		173.	.0	530.	6.1	.4
11 05 81 1115	0479	8.2		133.	.0	339.	1.7	4.3
01 06 81 1430	0479	8.2		120.	.0	283.	.9	5.1
01 07 81 1100	0479	8.5		127.	.9	298.	1.3	3.5
17 08 81 1045	0479	8.6		131.	3.8	376.	5.0	.4
21 09 81 1015	0479	8.5		136.	2.0	424.	5.5	.4
19 10 81 1015	0479	8.5		155.	1.0	503.	9.9	L.1
16 11 81 1200	0479	8.5		155.	.2	441.	5.5	.1
15 12 81 1310	0479	8.1		202.	.0	537.	7.7	.8
25 01 82 1215	0479	7.4		207.	.0	538.	16.0	4.0
16 02 82 1245	0479	7.5		190.	.0	500.	9.4	4.0
22 03 82 1200	0479	7.8		150.	.0	455.	6.8	2.0
26 04 82 1130	0479	8.4		160.	.5	470.	5.8	.2

NAQUADAT DETAILED REPORT
PHOSPHORUS AND NITROGEN FORMS

STATION 00AL05AK0001 LAT. 50D 44M 15S LONG. 110D 5M 45S PR 4 UTM 12 563800E 5620800N
SOUTH SASKATCHEWAN RIVER AT HWY 41, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15301L PHOSPHORUS TOTAL INORGANIC P MG/L	15103D PHOSPHORUS DISSOLVED P MG/L	15356F PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	15256F PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	07651L NITROGEN DISSOLVED N MG/L	07110D NITROGEN DISSOLVED NO3 & NO2 N MG/L	07506L NITROGE TOTAL AMMONIA N MG/L
09 05 79 0720	0462	.136		.017 03L			.53	.29 10L	
12 06 79 0900	0462	.17		.013 03L			.17	.17 10L	
17 07 79 1040	0462	.023		L.003 03L			.14	L.01 10L	
21 08 79 1330	0462	.027		.007 03L			.33	.01 10L	
11 09 79 0935	0462	.013		.004 03L			.26	.02 10L	
23 10 79 0915	0462	.021		.010 03L			.23	.01 10L	
20 11 79 0930	0462	.039		.012 03L			1.3	1.2 10L	
04 12 79 1030	0462	.026		.023 03L			1.4	1.10 10L	
15 01 80 0845	0462	.073		.067 03L			1.6	1.5 10L	
19 02 80 0940	0462	.091		.074 03L			1.2	1.2 10L	
18 03 80 1005	0462	.21		.16 03L			1.9	1.4 10L	
15 04 80 0720	0462	.210		.077 03F			.99	.70 10F	
21 05 80 0615	0462	.069		.010 03F			.12	L.01 10F	
10 06 80 0630	0462	.290		.031 03F			.45	.30 10F	
29 07 80 0750	0462	.019		.007 03F			.29	L.01 10F	
12 08 80 0700	0462	.021		.009 03F			.15	L.01 10F	
09 09 80 0720	0462	.010		.006 03F			.23	L.01 10F	
21 10 80 0815	0462	.055		.003 03F			.35	.07 10F	
18 11 80 0900	0462	.063		.041 03F			.64	.58 10F	
09 12 80 0835	0462	.044		.033 03F			.98	.88 10F	
20 01 81 0900	0462	.093		.034 03F			.90	.62 10F	
17 02 81 0930	0462	.140		.090 03F			1.10	.95 10F	
17 03 81 0900	0462	.063		.038 03F			.79	.65 10F	
07 04 81 0840	0462	.20		.033 03F			.81	.62 10F	L.1
05 05 81 0750	0462	.15		.011 03F		L.003	.18	L.01 10F	L.1
23 06 81 0650	0462	.19		.020 03F		.010	.39	.29 10F	L.1
21 07 81 0550	0462	.066		.004 03F		L.003	.13	L.01 10F	
18 08 81 0715	0462	.037		.003 03F		L.003	.15	.01 10F	
22 09 81 0800	0462	.021		.006 03F		L.003	.20	L.01 10F	
27 10 81 0835	0462	.050		.013 03F		.010	.26 51F	L.01 10F	
17 11 81 0840	0462	.071		.029 03F		.018	.95	1.00 10F	
01 12 81 0845	0462	.100		.082 03F		.079	1.20	1.10 10F	
19 01 82 0950	0462	.190		.170 03F		.170	2.50	1.60 10F	L.1
09 02 82 0940	0462	.190		.180 03F		.170	1.90	1.60 10F	L.1
16 03 82 1030	0462	.240		.170 03L		.150 56L	1.60	1.50 10L	.5
20 04 82 0840	0462	.360		.068 03F		.060	.97	.68 10F	.2

NAQUADAT DETAILED REPORT
PARTICULATES TEMP DOC

STATION 00AL05AK0001 LAT. 50D 44M 15S LONG. 110D 5M 45S PR 4 UTM 12 563800E 5620800N
SOUTH SASKATCHEWAN RIVER AT HWY 41, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	02061F TEMPERATURE OF WATER DEG.C.	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	07902L NITROGEN PARTICUL. N MG/L	06902L CARBON ORGANIC PARTICULATE C MG/L	06104L CARBON DISSOLVED ORGANIC C MG/L
09 05 79 0720	0462	8.0 61S	93.	189.	172.	.05	.23	3.
12 06 79 0900	0462	17.5 61S	69.	128.	123.	.24	3.2	2.
17 07 79 1040	0462	22.5 61S	3.6	2.	2.	.03	.16	3.
21 08 79 1330	0462	24.5 61S	.3	L1.	L1.	.07	.25	3.
11 09 79 0935	0462	14.5 61S	.6	L1.	L1.	.05	.27	2.
23 10 79 0915	0462	5. 61S	3.0	2.	L1.	.10	.45	3.
20 11 79 0930	0462	.0 61S	3.1	19.	10.	.09	.54	2.
04 12 79 1030	0462	.5 61S	1.2	1.	L1.	.08	.25	2.
15 01 80 0845	0462	.5	1.6	5.	5.	.06	.19	2.
19 02 80 0940	0462	.0	2.6	4.	3.	.05	.31	1.
18 03 80 1005	0462	2.0	7.2	8.	4.	.13	2.0	3.
15 04 80 0720	0462	8.0	40.0	66.		.23	.85	4. 04F
21 05 80 0615	0462	18.5	14.0	35.	32.	.22	1.60	3.
10 06 80 0630	0462	15.0	95.0	241.	220.	.58	5.30	3. 04F
29 07 80 0750	0462	21.0	5.3	7.	5.	.15	.41	3. 04F
12 08 80 0700	0462	16.0	4.2	6.	6.	.08	.50	3. 04F
09 09 80 0720	0462	13.5	3.5	7.	5.	.06	.33	3. 04F
21 10 80 0815	0462	5.0	37.0	49.	45.	.35	2.70	2. 04F
18 11 80 0900	0462	.5	8.5	14.	11.	.11	.72	2. 04F
09 12 80 0835	0462	.0	2.6	2.	2.	.06	.26	2. 04F
20 01 81 0900	0462	.0	6.3	11.	9.	.10	.68	2. 04F
17 02 81 0930	0462	1.0	22.0	39.		.13	.76	2. 04F
17 03 81 0900	0462	.5	8.4	11.	8.	.16	.63	2. 04F
07 04 81 0840	0462	4.0	45.	104.		.78	4.8	
05 05 81 0750	0462	9.5	23.	61.	50.	.52	5.6	3.
23 06 81 0650	0462	14.	75.	180.	168.	.38	4.9	4.
21 07 81 0550	0462	21.0	40.0	70.		.25	2.10	2.
18 08 81 0715	0462	20.0	18.0	29.	27.	.26	1.40	2.
22 09 81 0800	0462	11.0	4.7	13.		.06	.43	2.
27 10 81 0835	0462	3.5	7.1	12.	7.	.23	1.30	5.
17 11 81 0840	0462	3.0	16.0	22.	18.	.17	1.10	2.
01 12 81 0845	0462	.0	3.3	2.	1.	.05	.33	2.
19 01 82 0950	0462	.0	3.0	5.	3.	.05	.26	3.
09 02 82 0940	0462	.0	3.0	1.	L1.	L.01	.22	2.
16 03 82 1030	0462	1.5	25.0	36.	30.	.26	1.50	4.
20 04 82 0840	0462	2.0	75.0	224.	208.	.76	5.40	3.

NAQUADAT DETAILED REPORT

PH DIC ALK COND CL SIO2

STATION 00AL05AK0001 LAT. 50D 44M 15S LONG. 110D 5M 45S PR 4 UTM 12 563800E 5620800N
SOUTH SASKATCHEWAN RIVER AT HWY 41, ALBERTA

SAMPLE DATE MST D M Y HR	SUBM ID	10301L PH PH UNITS	06152F CARBON DISSOLVED INORGANIC C MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	02041L SPECIFIC CONDUCT. US/CM	17206L CHLORIDE DISSOLVED CL MG/L	14105L SILICA REACTIVE SIO2 MG/L
09 05 79 0720	0462	7.9	34. 52L	130. 06L		342.	3.2	4.4
12 06 79 0900	0462	8.0	26. 52L	102. 06L		293.	1.6	3.6
17 07 79 1040	0462	8.5	23. 52L	99. 06L	.0	356.	3.9	.8
21 08 79 1330	0462	8.2	22. 52L	88. 06L	.0	400.	4.2	.2
11 09 79 0935	0462	8.2	24. 52L	106. 06L	.0	437.	6.4	.3
23 10 79 0915	0462	8.3	31. 52L	135. 06L	.0	494.	6.0	.2
20 11 79 0930	0462	8.2	36. 52L	142. 06L	.0	484.	7.7	.2
04 12 79 1030	0462	8.2	39. 52L	154. 06L	.0	594.	9.6	L.1
15 01 80 0845	0462	8.0	40. 52L	164. 06L	.0	578.	8.9	1.0
19 02 80 0940	0462	8.2	29. 52L	180. 06L	.0	524.	9.4	.5
18 03 80 1005	0462	7.7	[illegible]	[illegible]	.0	506.	9.6	3.0
15 04 80 0720	0462	8.0		120.	.0	419.	5.4	2.9
21 05 80 0615	0462	8.6		119.	2.3	362.	3.2	.2
10 06 80 0630	0462	7.9		114.	.0	316.	1.8	4.0
29 07 80 0750	0462	8.9		110.	6.4	428.	5.1	.6
12 08 80 0700	0462	8.8		112.	4.4	410.	5.8	.2
09 09 80 0720	0462	8.5		105.	.0	400.	5.6	.4
21 10 80 0815	0462	8.3		138.	.0	428.	5.7	.4
18 11 80 0900	0462	8.4		140.	1.7	409.	4.4	.2
09 12 80 0835	0462	8.3		160.	.0	494.	6.6	.5
20 01 81 0900	0462	8.0		150.	.0	430.	4.4	4.3
17 02 81 0930	0462	7.8		152.	.0	463.	5.8	3.3
17 03 81 0900	0462	8.3		123.	.0	403.	5.5	.8
07 04 81 0840	0462	8.5		148.	.0	497.	9.6	.3
05 05 81 0750	0462	8.8		106.	8.0	325.	4.4	L.1
23 06 81 0650	0462	8.3		127.	.0	324.	1.8	5.0
21 07 81 0550	0462	8.5		120.	2.8	329.	2.9	.5
18 08 81 0715	0462	8.6		116.	1.9	325.	2.8	1.0
22 09 81 0800	0462	8.6		113.	1.6	363.	4.7	.4
27 10 81 0835	0462	8.3		150.	.0	518.	7.6	L.1
17 11 81 0840	0462	8.3		143.	.0	413.	5.8	.2
01 12 81 0845	0462	8.3		163.	.0	467.	6.7	.1
19 01 82 0950	0462	7.6		227.	.0	592.	12.0	3.8
09 02 82 0940	0462	7.5		185.	.0	493.	7.9	4.4
16 03 82 1030	0462	7.5		135.	.0	404.	7.5	3.0
20 04 82 0840	0462	7.7		110.	.0	397.	7.8	3.0

CA2ALEN 18
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Pt2 c. 2

The Limnological Characteristics of the Bow, Oldman and South Saskatchewan Rivers (1979 – [illegible]) Part II

Alberta
ENVIRONMENT
Environmental Protection Services
Pollution Control Division
Water Quality Control Branch

SP 502/86.

THE LIMNOLOGICAL CHARACTERISTICS OF THE BOW, OLDMAN AND SOUTH SASKATCHEWAN RIVERS (1979 - 82)

PART II

THE PRIMARY PRODUCERS

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EXECUTIVE SUMMARY

The South Saskatchewan River Basin Study was initiated to address public concerns that water quality was deteriorating among the rivers. The Water Quality Control Branch began the study in 1979: its purpose was to define quantitatively the limnological characteristics of the Bow, Oldman and South Saskatchewan Rivers. This report is the second of two. Report I by Cross, Hamilton and Charlton 1986 presents the water chemistry findings. This report II presents an interpretation of the water quality and relates it to primary producer abundance and productivity. The primary producers of the Bow, Oldman and South Saskatchewan Rivers increase and decrease in response to a myriad of physical, chemical and climatological factors.

Standing crops of both macrophytes and algae are highest in the middle reaches of the rivers and downstream of nutrient additions from sewage treatment plants. Their distribution and abundance are primarily controlled by phosphorus, discharge and temperature. Macrophytes are specifically inhibited by river velocities exceeding 0.40 $m \bullet sec^{-1}$ and phosphorus concentrations of less than 0.010 $mg \bullet L^{-1}$. Algae are also limited by these physical and chemical factors; however, they are much more opportunistic than macrophytes and respond very rapidly despite physical disruption of their communities.

This investigation documented the important role of phosphorus as the primary nutrient responsible for eutrophication of the Bow River. Now it remains to be seen whether or not phosphorus reductions in the Bow River will decrease standing crops of macrophytes and algae within the enriched river zones.

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1.0 INTRODUCTION

The physiology of aquatic plants is similar in many respects to that of terrestrial plants. Aquatic plants absorb various nutrients from their surrounding medium and by photosynthesis, release oxygen and various other metabolic by-products into waters. They are the most important primary producers in the food chain and are essential for aquatic ecosystems. When too numerous, aquatic plants become a nuisance: they interfere with recreational activities; they impede the flow of water in irrigation canals and they affect the appearance, taste, odor and suitability of water for human consumption.

Observations throughout the South Saskatchewan River Basin indicated that aquatic plants were most prolific downstream of Calgary (between Calgary and Carseland), while filamentous algae were more abundant in the middle and lower reaches of the Bow, Oldman and South Saskatchewan rivers (Exner 1977).

Nuisance aquatic plants clogged water intakes and outlets to irrigation districts, resulting in an estimated $1,000,000 in direct costs and lost agricultural production during 1976 (Exner 1977). This study was started in 1978/79 in order to assess the factors controlling the distribution and abundance of aquatic plants throughout the basin.

The most intensive aspects of the study on aquatic plants and role of nutrients and physical variables were carried out by us between 1980 and 1983. The specific aquatic plant communities found here include the microscopic algal assemblage found attached to rocks (epilithic), or freely floating (phytoplankton), and the non-vascular, macroscopic assemblages (hydrophytes, submerged macrophytes) found growing attached to the river bottoms.

1.1 Objectives

The specific objectives of the study were to:

1. define species composition and microhabitat preferences of aquatic plants;
2. determine aquatic plant growth patterns according to season and distribution;
3. establish the relationship between aquatic plant growth and ambient river phosphorus concentrations;
4. define the role of various physical factors (i.e. discharge, temperature, light, velocity) as they affect plant growth; and
5. study the relationship between macrophytes and epilithic algae.

This study was coordinated with the report by Cross et al. 1986, and major aspects of the field data were gathered at the same time.

2.0 METHODS AND MATERIALS

2.1 Sampling Sites

Detailed examination of seasonal and annual aquatic plant patterns of development was conducted throughout the South Saskatchewan River Basin. Algae were routinely monitored at six sites on the Bow River (1, 2, 5, 6, 13, 7), three sites on the Oldman River (3, 4, 8) and four sites on the South Saskatchewan River (9, 10, 11, 12) (Figure 1). Macrophytes and algae were also monitored at thirteen sites along the Bow River between Calgary and Carseland, a region supporting nuisance level growths of aquatic plants (Figure 2). Surveys were also conducted over the entire basin to assess the characteristics along the courses of the Bow, Oldman and South Saskatchewan rivers (Figure 1).

Although algae and macrophytes are similar with respect to their metabolic processes, they are very different with respect to their morphological characteristics. Therefore, the methods employed to estimate their relative abundances must also differ. For this study, algal biomass was determined by using chlorophyll a and direct counts. Macrophyte biomass was determined by weighing organic material dried at 105°C for 24-48 hours in the manner used by Westlake (1965).

2.2 Aquatic Plant Standing Crops

Epilithic algal biomass was confirmed by direct counts and by chlorophyll a content of the entire community. Individual cell volumes were not calculated because of the inherent errors and

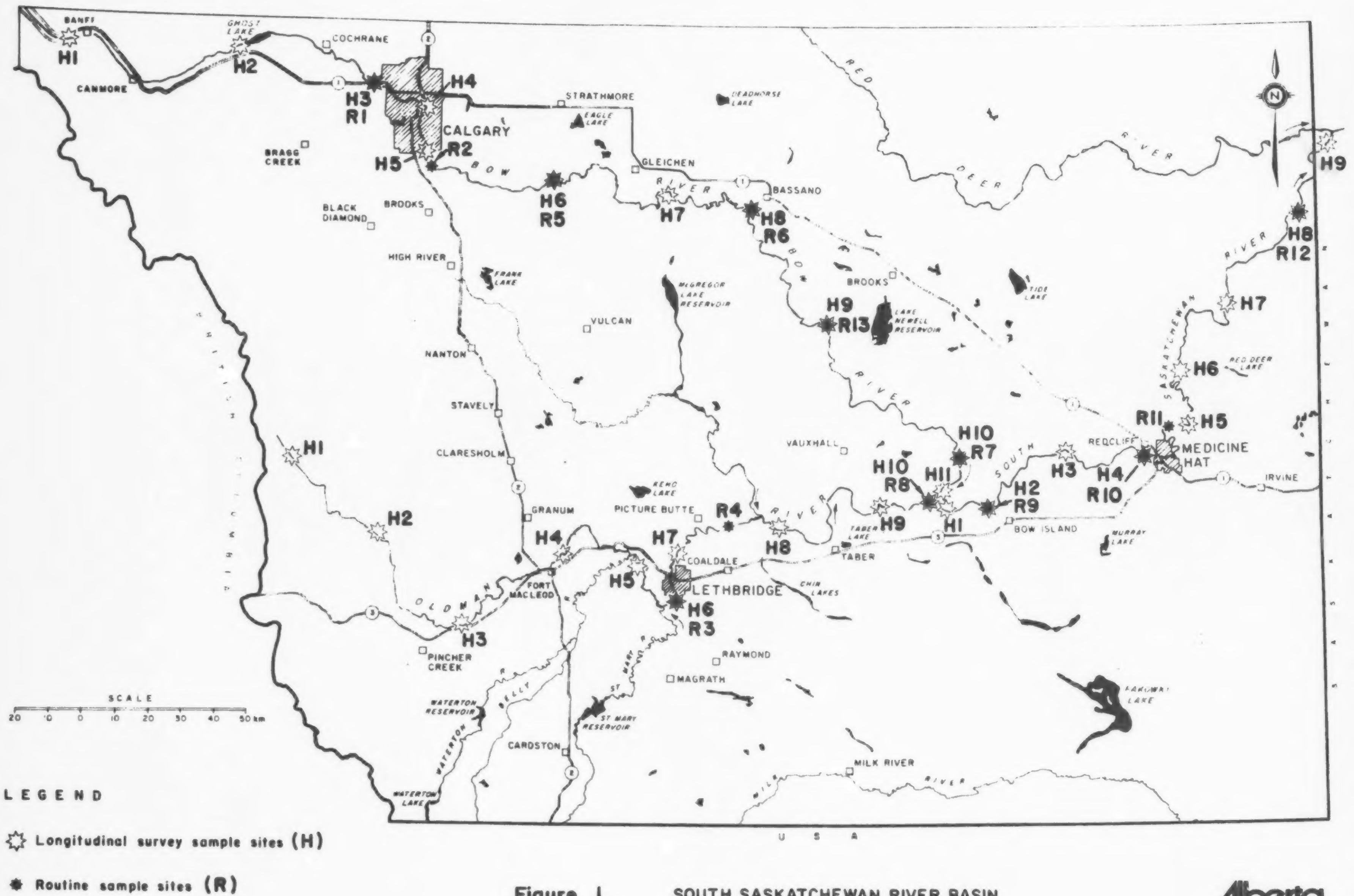
BANFF
H1
CANMORE
GHOST LAKE
H2
COCHRANE
H3
R1
H4
CALGARY
R2
H5
BRAGG CREEK
BLACK DIAMOND
BROOKS
HIGH RIVER
STRATHMORE
EAGLE LAKE
DEADHORSE LAKE
GLEICHEN
BOW
RIVER
H6
R5
H7
BASSANO
H8
R6
FRANK LAKE
McGREGOR LAKE RESERVOIR
VULCAN
BROOKS
H9
R13
LAKE NEWELL RESERVOIR
TIDE LAKE
RED
DEER
RIVER
H9
H8
R12
H7
SASKATCHEWAN
H6
RED DEER LAKE
R11
H5
MEDICINE HAT
REDCLIFF
H3
H4/
R10
IRVINE
SOUTH
H2
R9
BOW ISLAND
MURRAY LAKE
H10
R7
H10
R8
H11
H1
VAUXHALL
H9
TABER LAKE
TABER
NANTON
STAVELY
CLARESHOLM
GRANUM
H1
H2
H4
FORT MACLEOD
OLDMAN
H3
PINCHER CREEK
RENO LAKE
PICTURE BUTTE
R4
H7
H8
COALDALE
H5
LETHBRIDGE
H6
R3
CHIN LAKES
RAYMOND
MAGRATH
ST MARY
ST MARY RESERVOIR
WATERTON RESERVOIR
BELLY
WATERTON
WATERTON LAKE
CARDSTON
MILK RIVER
MILK
RIVER
KAHOWAI LAKE
BRITISH COLUMBIA
SASKATCHEWAN
U S A
N
SCALE
20
10
0
10
20
30
40
50 km
LEGEND
Longitudinal survey sample sites (H)
Routine sample sites (R)

Figure I. SOUTH SASKATCHEWAN RIVER BASIN

STUDY SAMPLING SITES

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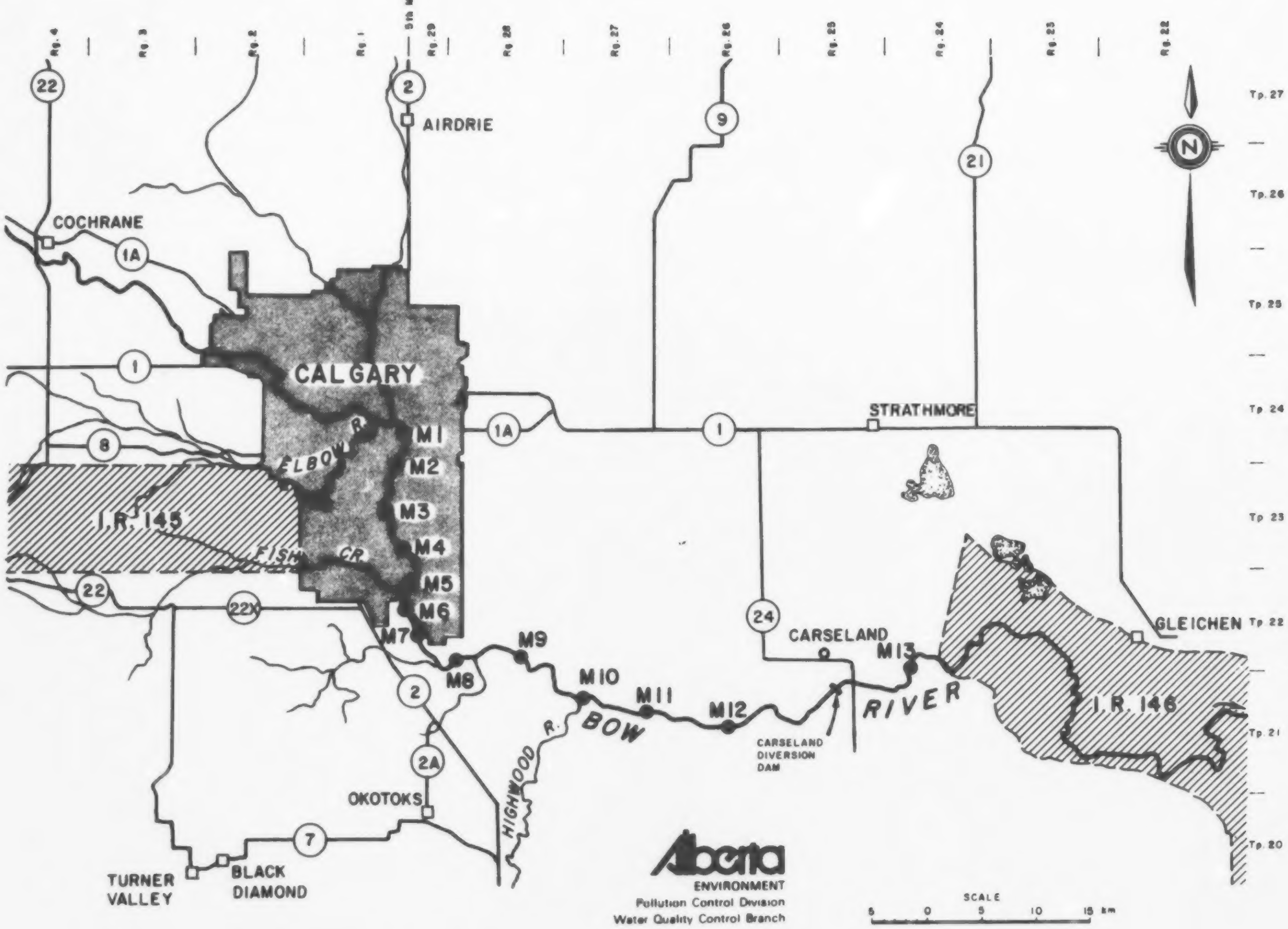
Rg. 4
Rg. 3
Rg. 2
Rg. 1
5th Mer
Rg. 29
Rg. 28
Rg. 27
Rg. 26
Rg. 25
Rg. 24
Rg. 23
Rg. 22
Tp. 27
Tp. 26
Tp. 25
Tp. 24
Tp. 23
Tp. 22
Tp. 21
Tp. 20
N
22
2
AIRDRIE
9
21
COCHRANE
1A
1
CALGARY
STRATHMORE
8
ELBOW R.
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
M11
M12
M13
I.R. 145
FISH CR.
22
22X
24
CARSELAND
GLEICHEN
2
2A
HIGHWOOD R.
BOW
RIVER
I.R. 146
CARSELAND DIVERSION DAM
OKOTOKS
7
TURNER VALLEY
BLACK DIAMOND
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SCALE
5 0 5 10 15 km

Figure 2. Bonnybrook Study sampling sites.

difficulty associated with defining cell size and shape. Moreover, algal cell sizes frequently vary, not only within species, but also seasonally. Direct counts of cells provide a numerical estimate of population size which is consistent and directly comparable to the literature. Chlorophyll a reflects the quantity of pigment present and therefore, potential for photosynthesis, as it is the pigment directly involved in photosynthesis. The use of this parameter is consistent with the literature.

2.3 Algal Chlorophyll a

Chlorophyll a was utilized as a measure of epilithic standing crop for entire rock surfaces in connection with primary productivity (^{14}C uptake) measurements. Upon termination of the primary productivity incubation period, individual rocks were removed from their incubation chambers and immediately brushed clean to remove the epilithic community. A known volume of slurry (depending upon observed population size) was filtered onto a Whatman GF/C glass fibre filter, covered with anhydrous magnesium carbonate, wrapped in aluminum foil and stored at -4° C until shipped to the University of Alberta, Edmonton, for analysis.

Pigments were extracted into 90% acetone at -4° C for 24 hours in the dark after homogenization, using a Polytron PCU-2-110 homogenizer. The spectrophotometric method and equations of Moss (1967a, 1967b) were used. Normality of the hydrochloric acid did not exceed that recommended by Riemann (1978).

Planktonic algae have also proven to contribute to algal standing crops in lotic systems (Patrick 1961; Swale 1964). Therefore, one litre water samples were collected 15 cm below the water surface as far as possible from the shoreline and also filtered onto glass fibre filters for chlorophyll a determinations.

2.4 Algal Numbers and Species Composition

Algae growing attached to rock (epilithon) were sampled as follows. Duplicate 4 cm^2 areas of substrate were delineated by a template and the area within scraped with a sharp scalpel to remove algae. The community was placed in sterile 30 mL vials, together with 10 mL distilled water and ten drops of Lugol's iodine solution as preservative.

Species composition and algal numbers were determined using the inverted microscope (Biostar A.O.) and sedimentation technique (Lund et al. 1958). Continuous transects were examined under 45x and 100x magnification and the algae identified and counted. A minimum of 200, but more frequently 900-2000, algae were enumerated. To enable diatoms to be identified, subsamples were treated with a mixture of concentrated sulphuric acid, potassium dichromate and hydrogen peroxide to remove organic matter. This was followed by repeated washings in distilled water to remove all traces of acid, slow drying of the cleaned diatom frustules onto coverglasses and mounting in Hyrax. Algae were identified according to Prescott (1961), Patrick and Reimer (1966, 1975), Cleve-Euler (1951-1955) and Hustedt (1930a, 1930b, 1959, 1961-66).

2.5 Macrophyte Standing Crop

Aquatic macrophytes were monitored quantitatively using a quadrat collection technique. Once every two weeks during the period July through mid-September, representative transects from shore to a maximum possible working depth were sampled at right and left bank locations. Quadrats were defined and the plants within the perimeter removed down to a substrate depth of 0.20 m. A net (3 mm mesh) attached to the downstream side of the quadrat was utilized to collect dislodged plant material. All material was washed (in situ) to remove twigs, leaves and non-organic matter. Initially, a m^2 quadrat was employed in 1979/80; however, after 1980, the quadrat size was reduced to .093 m^2 (1 ft^2) because of the large volume of organic material present in most quadrats. In the laboratory, the plant material was given a final wash and oven dried at 105° C for 24-48 hours, then weighed to determine biomass. Sample replication was limited during 1980, at the peak biomass period, by the large quantity of material collected and the problem of rapid decay following collection. Therefore, during 1981, samples over 200 grams were also centrifuged (manual, 12:1 gear ratio spinner) for one minute and weighed on a hanging scale, in order to establish a wet to dry weight conversion factor. Specific wet to dry weight ratios were derived by weighing 100 grams (fresh weight samples) which had been dried at 105° C for 24 hours. The average ratio for the Bow River was 7.1:1 (S.D. = 0.85).

During 1981, sample replication was standardized to six quadrats three paces apart along each transect. SCUBA equipment was used to collect samples to a depth of 1.5 m. Water velocity and depth were recorded for the first and last quadrats of each transect. Water chemistry was also determined at each sample site (i.e. Site M left bank and M right bank). During 1982, seasonal biomass was determined at five locations only. Sampling procedures were the same as those already outlined except for the establishment of a benchmark at each site to ensure subsequent sampling at exact points upstream of previous transect areas. Peak biomass was estimated at all sampling sites (M1-M13) during early September, 1982. During 1983, the same procedures were employed at three sites (M3R, M4R, M6L) to monitor seasonal growth. Peak biomass was estimated for all thirteen sampling locations during September.

2.6 Physical Factors

River velocity was measured at 0.20, 0.60 and 0.80 metre depths, using a Teledyne Gurley Flow Meter. Insolation (surface, subsurface, bottom) was measured with a Protomatic light meter. Bow River discharge data were provided by Water Survey of Canada.

2.7 Algal Primary Productivity (Temporal)

Epilithic and planktonic productivity were measured using the ^{14}C technique. Individual rocks, together with their attached epilithic algae were transferred to 600 mL glass jars and inoculated with 10 µci $NaH^{14}CO_3$, then filled to the top with river water. This procedure limited an air space which has proven to affect ^{14}C availability

(Ilmavirta and Jones 1977). Duplicate dark jars and 12 to 15 light jars were incubated during each sample date. Jars containing only river water and ^{14}C were also incubated to estimate planktonic productivity. All experiments commenced at 10:00 hours and were terminated at 14:00 hours, Mountain Standard Time. At the end of the incubation period the algae were removed from the rocks as described earlier. Subsamples were taken for chlorophyll a analysis before the remaining slurry was preserved with buffered formalin. Each rock was also labelled and retained for surface area determination. Rock surface measurements were done with a planimeter.

Hydrochloric acid was used to acidify 20 mL subsamples of epilithic slurry to pH 2.0. These were then aerated for 30 minutes to remove unincorporated inorganic carbon-14 (Schindler et al. 1972). After aeration, 2 mL subsamples were placed in Aquasol fluor and the incorporated carbon-14 determined, using a Nuclear Chicago Scintillation counter, Model 6800. Corrections for quenching were made. Algal primary productivity was monitored throughout 1980 and 1981 in the South Saskatchewan River Basin.

2.8 Diurnal Epilithic Productivity

The diurnal pattern of ^{14}C uptake was investigated at Site 5 during October 15 and 16, 1981, in order to quantify productivity occurring prior to and following the 10:00 to 14:00 hour routine estimate of ^{14}C uptake. The procedure employed was identical to that already described except that a series of overlapping incubations were performed throughout the twenty-four hour period.

2.9 River Course Surveys

Routine investigation of aquatic plant communities throughout the basin was subject to temporal variation because of the time required for travel between sites. In order to overcome this variation, river course (one day) surveys were conducted by helicopter during early July, 1980/81 and early September, 1980/81, on each of the three rivers. At each of ten sites per river, physical, chemical and biotic samples were collected. Throughout the surveys, macrophyte observations were noted for ground-truthing that followed the helicopter survey. Sample collection and analysis are the same as those outlined already with the exception of epilithon which was derived by collection of five duplicate 4 cm^2 scrapes. Table 1 is a list of parameters determined for each site during the survey.

2.10 Three Site Study

In addition to those studies already described, there was a need to define the biotic and chemical differences between the Bow, Oldman and South Saskatchewan Rivers for an area subject to similar physical and climatological conditions. The confluence of the Oldman and Bow Rivers and the South Saskatchewan River immediately downstream provided a unique location where differences in the biotic and chemical regime are indeed a product of factors other than climate and physical geography (49° 51' 02" N, 111° 41' 48" W). Therefore, during September 30, 1980, primary production, algal standing crop and the physicochemical characteristics of the three rivers were compared quantitatively.

TABLE 1 Parameters determined at each river course survey site

PHYSICAL	CHEMICAL	ALGAL
Depth	pH	Standing Crop
Temperature	Total Alkalinity	Chlorophyll a
Site Description	Turbidity (JTU)	Epilithion
Conductance	DP (dissolved phosphorus)	Phytoplankton
Dissolved Oxygen	OP (ortho phosphorus)	
	DN (dissolved nitrogen)	
	NFR (non-filterable residue)	
	Si (silica)	
	DOC (dissolved organic carbon)	
	DIC (dissolved inorganic carbon)	
	NFFR (fixed non-filterable residue)	
	TP (total phosphorus)	
	TN (total nitrogen)	
	POC (particulate organic carbon)	
	Chloride	

3.0 RESULTS

3.1 Temporal Patterns (Epilithic Algal Numbers, Species Dominants and Percent Composition

3.1.1 The Bow River

Cyanophycean algae were numerically dominant throughout the Bow River, followed by diatoms and green algae during 1980/81. Algal numbers were lowest above Calgary (Site 1) and higher downstream of Calgary (Sites 2, 5, 13) (Figure 3). Cell numbers ranged from 8 x 10^8 cells $\bullet m^{-2}$ at Site 1 (winter, 1980) to 165 x 10^9 cells$\bullet m^{-2}$ at Site 13 (fall, 1980). Table 2 indicates the dominant algal species found for all sites sampled throughout the basin.

Upstream of Calgary (Site 1), algal numbers fluctuated little except from March through to July, 1981. At that time diatoms and blue-green algae were dominant. Diatoms were relatively more abundant at Site 2 and 13 downstream of Calgary than at any other study sites on the Bow River; annual patterns consistently reflected the occurrence of early fall peaks in addition to spring/summer peaks at Sites 2 and 13. Cyanophycean algal numbers fluctuated little annually (Figure 3) except at Site 1 during early 1981 and Site 13 during July/August, 1981. Green algae (Chlorophyta) and diatoms were also relatively more important numerically at Sites 2 and 13.

3.1.2 The Oldman River

The epilithic algal community of the Oldman River was also dominated by blue-green algae and diatoms (Figure 4). They ranged in

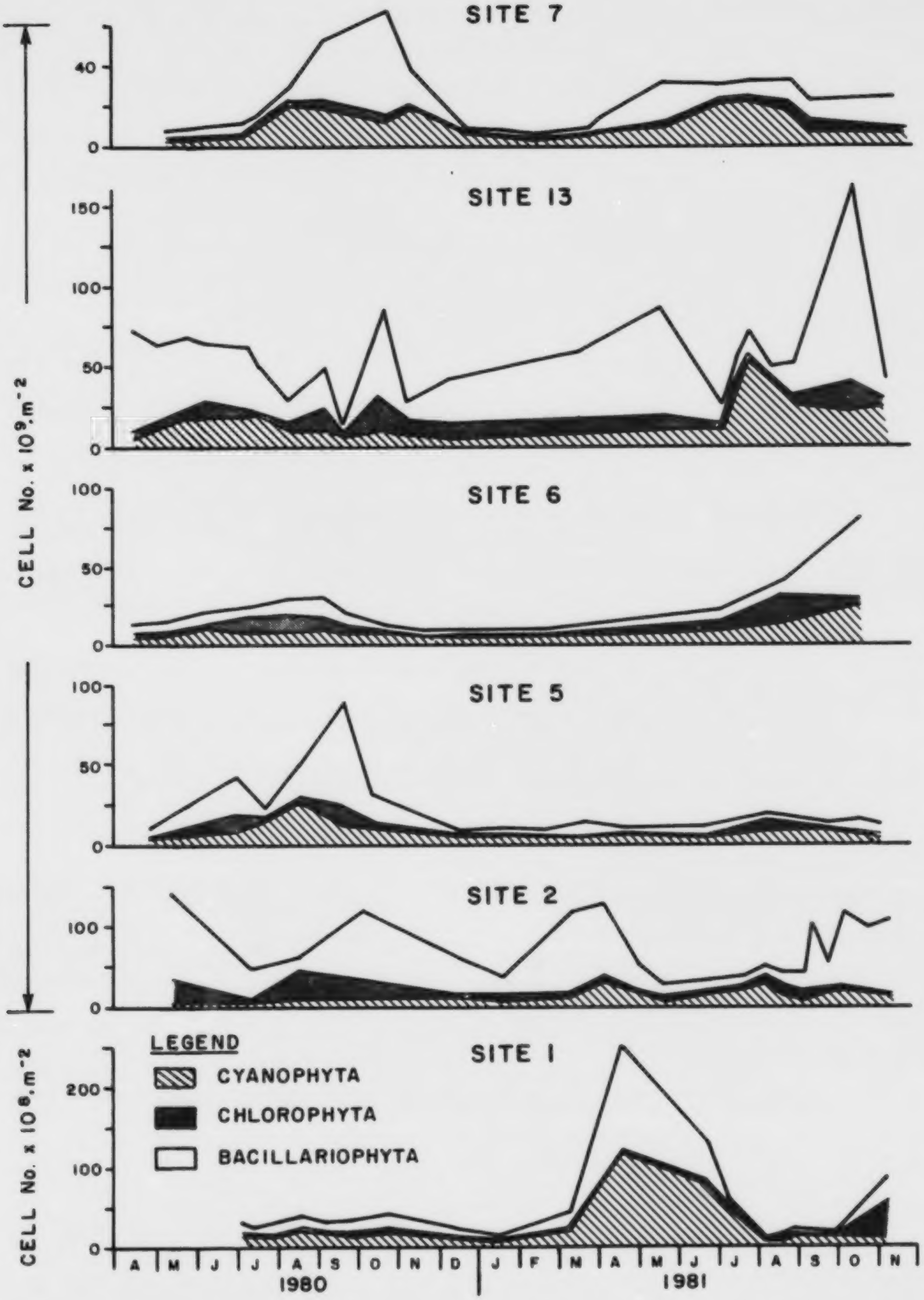

Figure 3. Epilithic algal cell numbers and relative percent composition for the dominant algal divisions occurring in the Bow River (1980/81).

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SPECIES	Bow						Oldman			SSR			
Chlorophyta	1	2	5	6	13	7	3	4	8	9	10	11	12
Chlamydomonas ehrenbergii			■										
Cladophora glomerate (L.) Kütz			▼ ■	▼ ■	▼ ■	▼	▼ ■	▼ ■	▼	▼ ■	▼ ■	▼ ■	▼ ■
Geminella mutabiilis (de Breb) Wille		▼											
Pithophora varia Wille	▼							▼		▼	▼ ■	▼ ■	▼
oedognoia (Mont) Wittrock							■	■					
Stigeoclonium nanum Kütz	▼ ■	■	▼ ■	▼ ■	▼					▼ ■			▼ ■
lubricum (Dillw.) Kütz					▼								
S. Pachydermum Prescott	■	▼ ■		▼		▼ ■							
S. Subsecundum Kütz	■												
Schizomeris Leibleinii Kütz		▼							■				
Scenedesmus quadricauda (Turp) de Breb				▼ ■	■		▼ ■		▼		▼ ■		
Ulothrix cylindricum Prescott	■												
zonata (Weber & Mohr) Kütz		▼ ■			▼ ■		▼	▼ ■	▼			▼ ■	
aequalis Kütz		▼						▼					
subtlissima Rabenhorst			▼		■								
variablis Kütz									■				

TABLE 2. DOMINANT EPLITHIC SPECIES FOR THE SOUTH SASKATCHEWAN RIVER BASIN 1980/81.

	Bow						Oldman			SSR			
	1	2	5	6	13	7	3	4	8	9	10	11	12
Cyanophyta													
Gleocapsa aeruginosa (Carm.) Kutz	▼												
Phormidium autumnale (As.)Gomont	▼ ■								▼				
tenue (Menegh) Gomont	■	▼ ■	▼ ■	▼ ■	■	▼ ■	▼ ■	▼ ■	■	▼ ■	▼ ■	▼ ■	▼ ■
musicola	■	■	■	▼ ■	▼ ■					▼ ■			
favosum (Bory) Gomont				■									
ambiguum Gomont			▼		▼	▼ ■					■	■	▼ ■
Microcystis aeruginosa Kutz emend Elenkin		▼	■										
Lyngbya-aerugineo-caerula (Kutz) Gomont		▼	▼	▼ ■	▼ ■	▼ ■	▼ ■	▼ ■	▼ ■		■	▼ ■	▼ ■
L. taylorii Drouet & Stickland										▼			
Oscillatoria tenuis C.A. Agardh.		■						▼			▼ ■	▼	▼ ■
tenuis var tergestina (Kutz) Rabenhorst..			▼	▼		▼ ■		▼		■			
Ankistrodesmus falcatus (Corda) Rolff			▼				▼	▼ ■	■	■	■	▼ ■	■
Spirulina laxissima G.S. West			■										
Calothrix brevarticulata West and West							▼ ■	■					
Nostoc commune Vaucher						▼ ■	▼ ■						
Calothrix braunii Bornet and Flahault								▼	■	▼ ■			
epiphytica								■			▼	▼ ■	
Anabaena affinis Lemm.									▼		▼		

▼ Indicates dominant during 1980

■ Indicates dominant during 1981

SPECIES Bacillariophyta	Bow						Oldman			SSR			
	1	2	5	6	13	7	3	4	8	9	10	11	12
Achnanthes minutissima Kutz			■						▼	▼ ■	■	▼ ■	▼ ■
A. lanceolata Breb			■										
Cyelotella meneghiniana Kutz		■											
Cymbella gracilis (Rabh.) Cl.			■										
C. ventricosa Kutz		▼		■	▼ ■			▼ ■					
Diatoma anceps (Ehr) Grunn.						▼				▼ ■			
D. vulgare Bory	▼												
D. hiemale (Lyngby.) Heiberg	■		▼		■								
Epithemia Sorex Kutz							■	▼ ■	▼ ■				
Fragilaria construens (Ehr) Grun.		▼											
intermedia Grun		■											
Gomphonema olivaceum (Lyngb.) Kutz		▼		▼			▼				▼ ■	■	▼ ■
N. amphibia Grun		▼ ■							▼ ■	■	▼ ■		
N. dissipata (Kutz) Grun			▼							▼			
Nitzchia fonticola Grun	▼			■				▼					
N. holstatica Hust					▼	▼ ■						▼	▼
N. palea (Kutz) W. Sm.		■	▼		▼ ■			■				▼ ■	■
Navicula hungarica Grun	■					■							
N. cryptocephala Kutz		■	▼	▼	■	■	▼ ■	■		▼			
N. viridula Kutz					▼								
Rhicosphenia curvata (Kutz) Grun	■												
Synedra ulna (Nitzsch) Ebr.	■								■	■			
Surirella splendida (Ehr) Kutz			■										
S. ovata Kutz				▼ ■		▼	▼	▼					
Tabellaria fenestrata (Lyngby.) Kutz	▼ ■												

▼ Indicates dominant during 1980

■ Indicates dominant during 1981

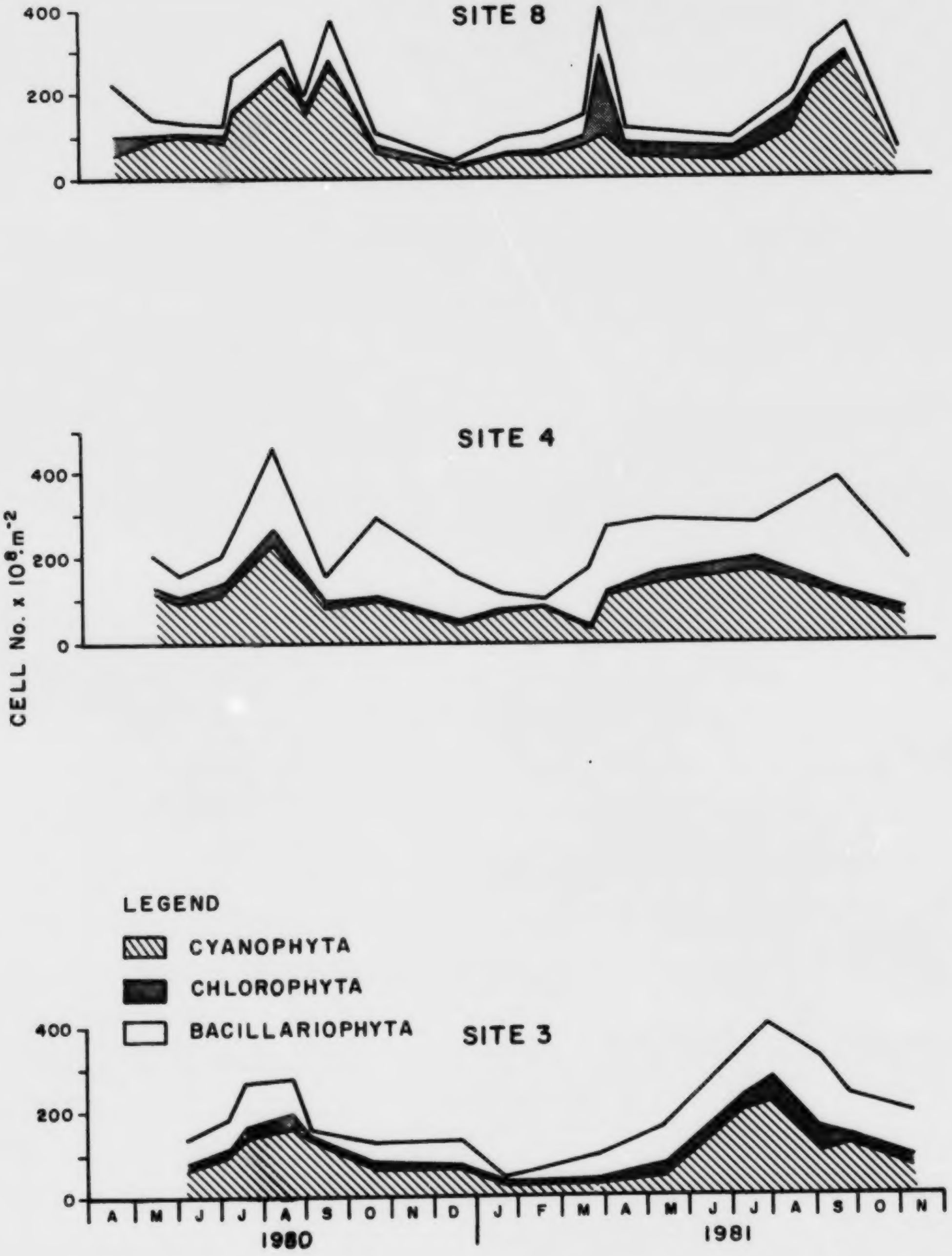

Figure 4. Epilithic algal cell numbers and relative percent composition for the dominant algal divisions occurring in the Oldman River (1980/81).

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numbers from 40 x 10^8 cells•m^{-2} (winter) at Site 3 above Lethbridge to 454 x 10^8 cells•m^{-2} (summer) at Site 4, downstream of Lethbridge. Diatoms were relatively more abundant in the vicinity of Lethbridge, particularly downstream of Lethbridge (Figure 4). Filamentous green algae were found throughout the Oldman River (Table 2) and were relatively more abundant upstream of Lethbridge and at Site 8 near the mouth of the Oldman River. Green algal abundance was higher during the summer of 1981. Cyanophycean algal numbers peaked each year during the summer season (June through early September). Interestingly, Nostoc commune, a known nitrogen fixing species, was dominant at Site 3 above Lethbridge.

3.1.3 The South Saskatchewan River

The epilithic algal community of the South Saskatchewan River was also dominated by blue-green algae and diatoms (Figure 5), except at Site 9 where green algae were frequently dominant during 1981. Algal numbers ranged from 70 x 10^8 cells•m^{-2} (winter) at Site 12 to 481 x 10^8 cells•m^{-2} (fall 1981) at Site 9. Epilithic algal numbers generally decreased in a downstream direction. The benthic algal community at Site 9, downstream of the confluence of the Bow and Oldman Rivers was dominated by diatoms during fall and winter (Figure 5). During the early spring/summer period, however, green algae (particularly filamentous forms) were abundant (Table 2).

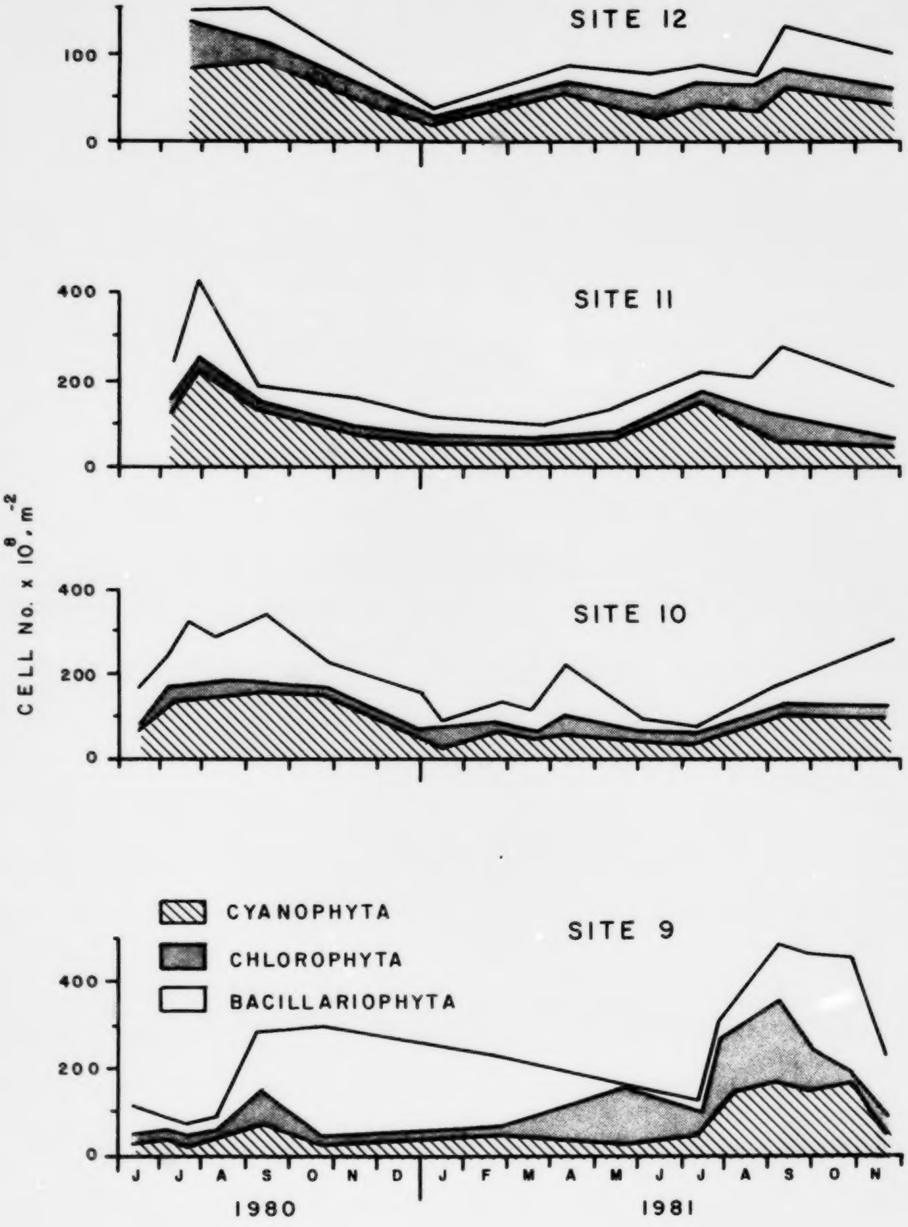

Figure 5. Epilithic algal cell numbers and relative percent composition for the dominant algal divisions occurring in the South Saskatchewan River (1980/81).

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The City of Medicine Hat, located upstream of Site 11, did not appear to influence algal abundance or composition significantly. The relative percent contribution by various algal divisions changed little throughout 1980 and 1981. Planktonic algal contribution to the benthic algal community in the South Saskatchewan River was greater than that observed for either the Bow or the Oldman River. This finding was related to the large slow-flowing nature of the South Saskatchewan River.

3.1.4 Summary

The epilithic algal communities of the South Saskatchewan River Basin are most often numerically dominated by microscopic blue-green algae and diatoms. Diatoms were relatively more abundant downstream of Calgary and Lethbridge. The convergence of the Bow and Oldman Rivers, forming the origin of the South Saskatchewan River at Site 9, supported the largest relative contribution by green algae. Known nitrogen-fixing blue-green algal species were found to occur most frequently in the Oldman and lower Bow River reaches, possibly suggesting a nitrogen-limited lotic environment.

3.2 Temporal Patterns (Epilithic Chlorophyll a)

3.2.1 The Bow River

Epilithic algal chlorophyll a was investigated routinely at thirteen sites throughout the South Saskatchewan River Basin. In the Bow River average standing crops were lowest at Site 1 and high at Sites 2 and 5 located downstream of Calgary. Table 3 illustrates the average benthic algal standing crops for the entire study period by site for the Bow River.

TABLE 3 Seasonal mean and range for benthic algal standing crops in the South Saskatchewan River Basin (1980/81).

LOCATION SITE	mg CHLOROPHYLL $\underline{a}\cdot m^{-2}$ MEAN	RANGE	SEASON HIGHEST	 LOWEST
BOW RIVER				
1. Upstream of Calgary	31	11- 42	Sum/80	Spr/80
2. Downstream of Calgary	247	164-439	Fall/80	Sum/80
5. Carseland	296	108-409	Sum/80	Sum/81
6. Downstream of Bassano Dam	127	3-362	Fall/81	Win/80
13. Bow City	69	10-140	Fall/81	Win/80
7. Ronalane Bridge	75	33-114	Sum/80	Win/80
OLDMAN RIVER				
3. Upstream of Lethbridge	47	19- 72	Sum/81	Win/80
4. Downstream of Lethbridge	83	23-165	Sum/80	Win/80
8. Confluence with Bow River	22	13- 40	Fall/81	Win/80
SOUTH SASKATCHEWAN RIVER				
9. Bow Island	36	6- 65	Sum/80	Spr/81
10. Upstream of Medicine Hat	38	16- 67	Sum/80	Sum/81
11. Downstream of Medicine Hat	40	21- 50*	Fall/81	Fall/ Win/80
12. Highway 41	70	9-121	Sum/80	Win/80

* Data absent Spring/80
Spr = Spring - 20 March/19 June
Sum = Summer - 20 June/14 September
Fall = 15 September/01 December
Win = Winter - 02 December/19 March

All available algal standing crop data were used to determine whether or not the abundance of epilithic chlorophyll a was significantly different among sampling stations within each river. Analytical comparisons were derived from unpaired Student's t-tests. Discussion within this report is limited to those sites found to support significantly different epilithic algal biomass.

Epilithic standing crops were significantly lower (P = .01) at Site 1 than at any other Bow River site. Moreover, benthic algal standing crops that ranged from 11 to 42 mg chlorophyll $\underline{a}\bullet m^{-2}$ (Table 3) did not undergo dramatic seasonal fluctuations as compared with sites located downstream of Calgary (Figure 6).

Epilithic algal standing crops were highest and fluctuated widely at Sites 2, 5 and 6 (Figure 6). Site 2 supported an average 247 mg chlorophyll $\underline{a}\bullet m^{-2}$ during 1980, the highest values were found during the fall, the lowest in summer. Site 5 supported peak benthic standing crops during the summer (1980) and fall (1981) and averaged 296 mg chlorophyll $\underline{a}\bullet m^{-2}$. Standing crops at Sites 2 and 5 were not significantly different from each other but were significantly higher (P = .01) than at any other Bow River study site.

Benthic algal standing crops displayed similar trends at Sites 6 and 13 (Figure 6), characterized by a fall maximum and winter minimum. At Site 7, benthic algal standing crops were similarly low during the winter season but highest during the summer seasons and particularly during 1980 (Table 3 and Figure 6).

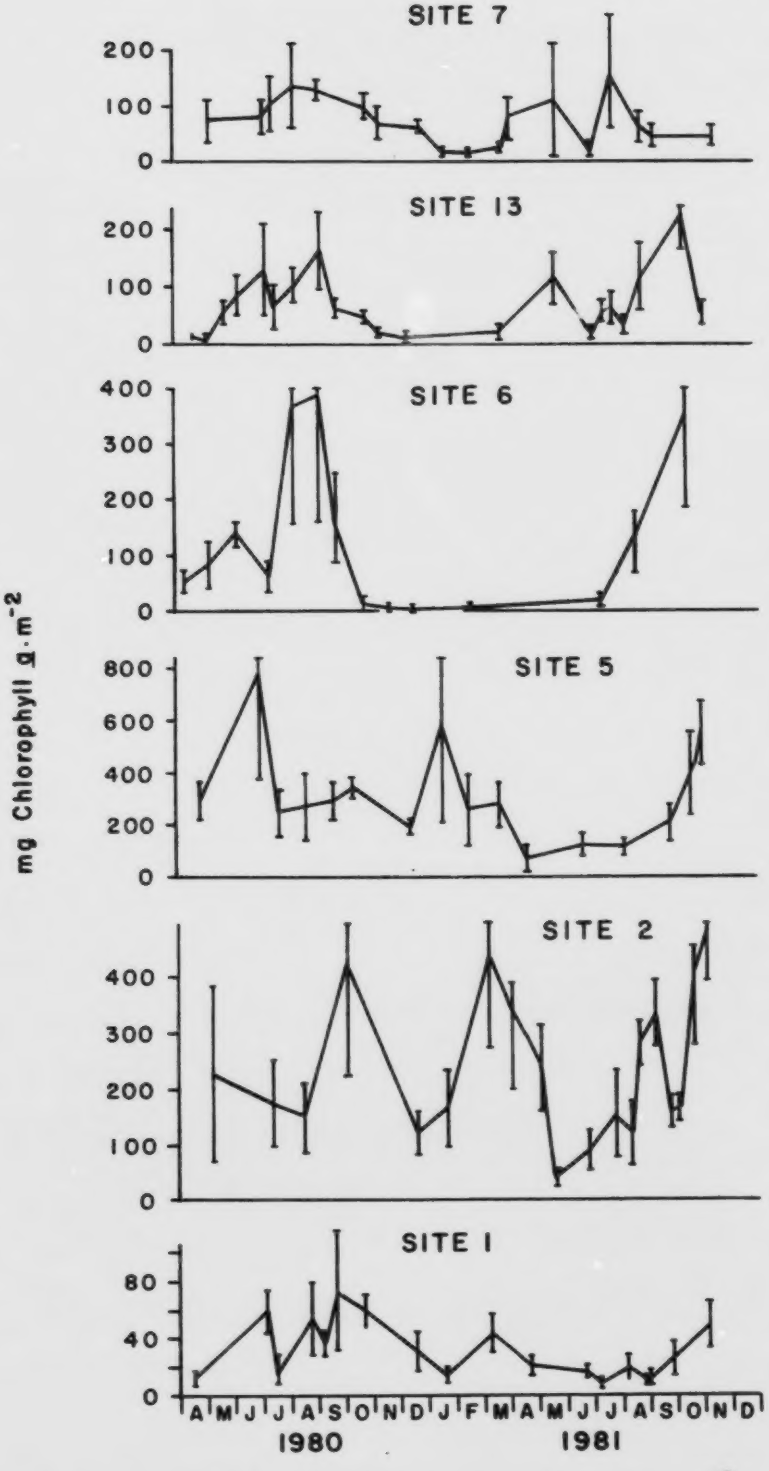

Figure 6 . Mean epilithic algal standing crops (mg Chl $\underline{a} \cdot m^{-2}$) and 95 % confidence limits for the Bow River (1980/81).

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3.2.2 The Oldman River

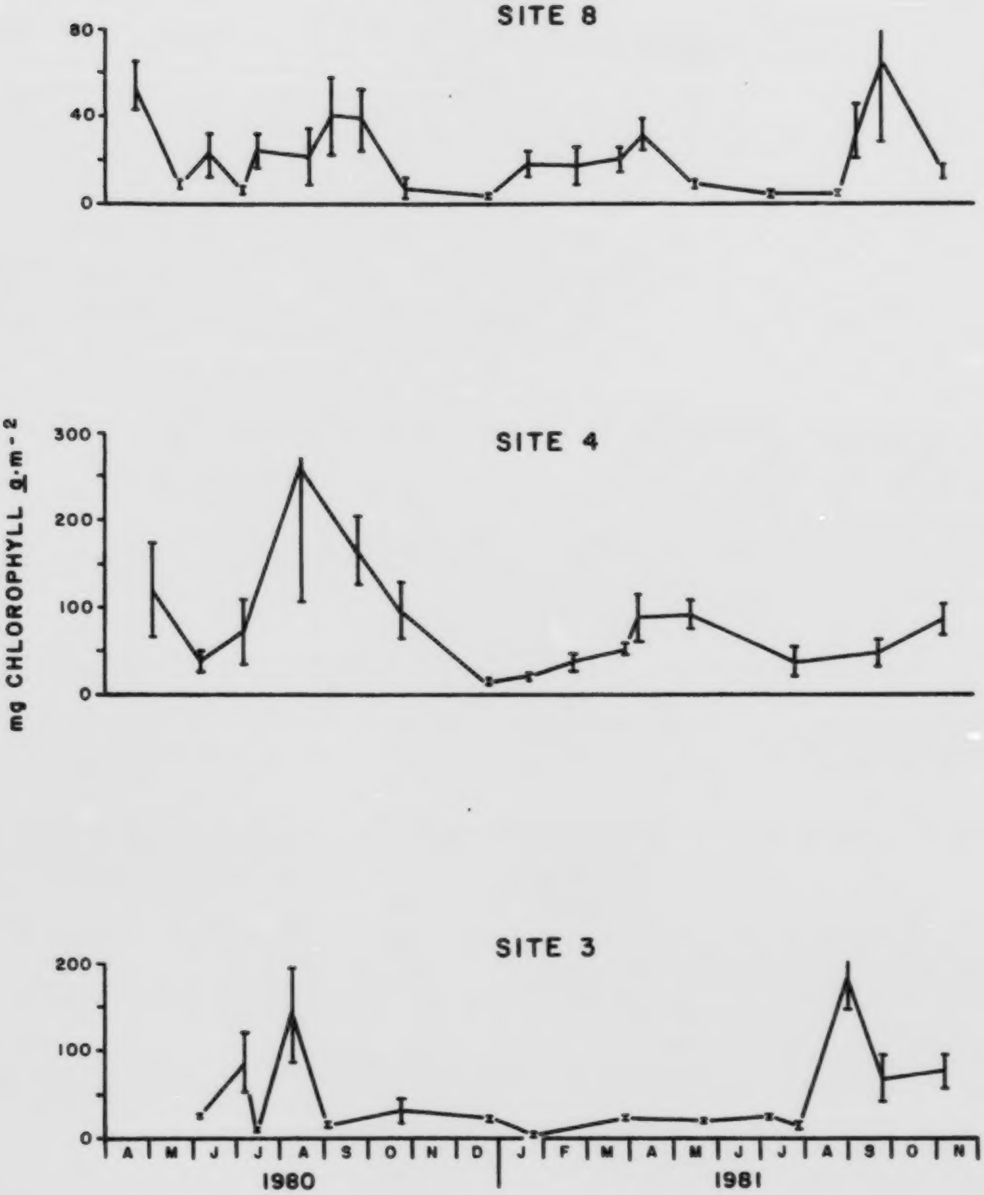
The seasonality of benthic algal standing crops was compared among three sites on the Oldman River. Table 3 provides mean seasonal chlorophyll a and Figure 7 illustrates the temporal patterns.

Benthic algal standing crops were highest overall in the Oldman River during 1980 reaching 260 mg chlorophyll a•m^{-2} (Figure 7) at Site 4. Moreover, benthic algal standing crops at Site 4 (downstream of Lethbridge) were nearly twice that found to occur at Site 3 (upstream of Lethbridge) when seasonal means were compared (Table 3), but far less than those reported for the Bow River downstream of Calgary. In the Oldman River (sites located near Lethbridge) algal standing crops were consistently highest during the summer and lowest during the winter. Chlorophyll a was also significantly higher at Site 4 ($P = .025$). In the lower reach of the Oldman River, algal standing crops were lowest during the winter and dissimilarly highest during the fall season (Table 3 and Figure 7). Sites 3 upstream of Lethbridge and 8 (lower Oldman River) were not significantly different ($P = .01$) with respect to epilithic standing crops.

3.2.3 The South Saskatchewan River

The seasonality of algal standing crops was compared among four sites on the South Saskatchewan River. Figure 8 and Table 3 present the temporal and seasonal data, respectively.

Maximum algal standing crops were found to occur during the summer at all sites except Site 11 downstream of Medicine Hat where a fall peak was found during 1981. Minimum standing crops occurred


SITE 8

SITE 4

SITE 3

Figure 7. Mean epilithic algal standing crops (mg Chl a·m^{-2}) and 95 % confidence limits for the Oldman River (1980/81).

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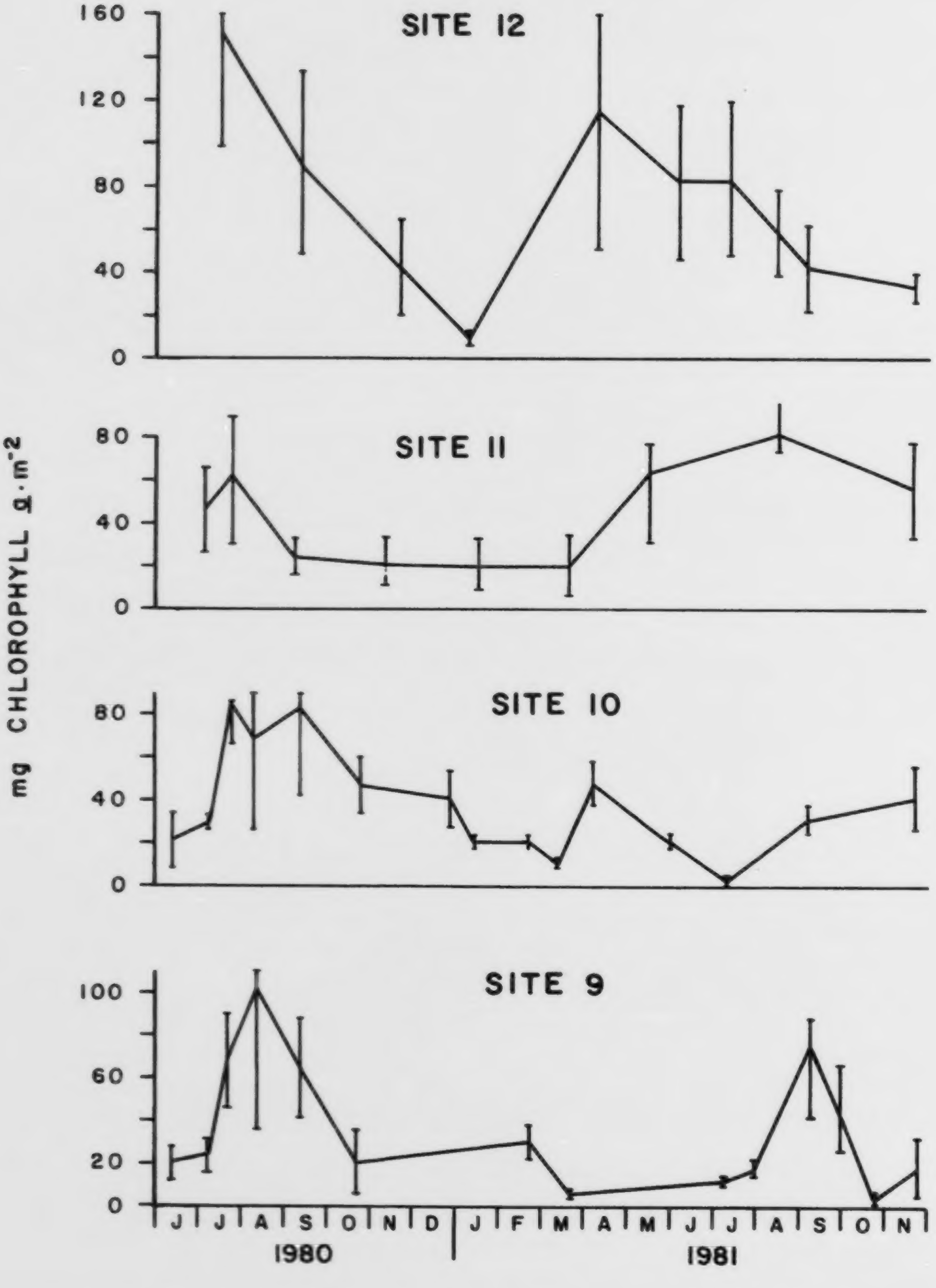

Figure 8. Mean epilithic algal standing crops (mg Chl $a \cdot m^{-2}$) and 95% confidence limits for the South Saskatchewan River (1980/81).

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during the spring/summer 1981 above Medicine Hat, and during the winter below Medicine Hat. The highest recorded standing crop was 152 mg chlorophyll a•m^{-2} at Site 12 during July, 1980. Only sites 10 and 12 proved to be significantly different (P = .05).

3.3 Temporal Pattern of Primary Productivity

3.3.1 The Bow River

Epilithic algal productivity was monitored routinely in conjunction with estimates of algal standing crop. While there was evidence of higher standing crops during 1980 compared to 1981, the difference with respect to productivity was profound (Figure 9). Uptake of ^{14}C was much lower during 1981. Table 4 presents the mean and range of seasonal production for the Bow River.

Seasonally, ^{14}C uptake ranged from 10 to 78 mg carbon•m^{-2}•h^{-1} at Site 1, with a pronounced maximum during the summer of 1980. Productivity at Site 1 reached 51 mg carbon•m^{-2}•h^{-1} during March, 1981 when a lack of ice cover contributed to the development of an extensive benthic algal community, mainly diatoms and blue-green algae. Statistically significant (P = .01) differences were found between Sites 1 and 2 productivity only.

Although primary productivity was monitored at Site 2 during 1980 and winter/early spring 1981, there is evidence to suggest that ^{14}C uptake immediately downstream of Calgary was highest during the fall season; moreover, benthic algae were least productive during summer (Table 4 and Figure 9) when macrophytes were particularly

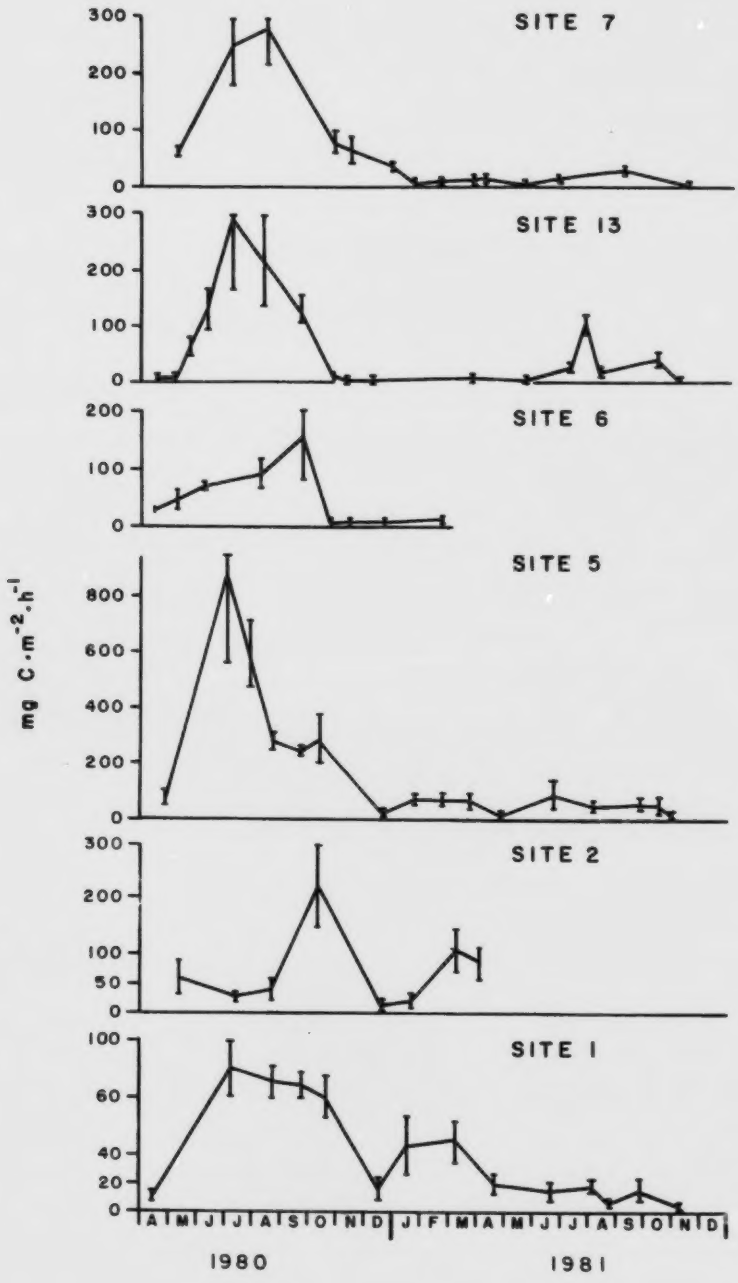

Figure 9. Mean epilithic algal primary productivity (mg Carbon · m^{-2} · h^{-1}) and 95 % confidence limits for the Bow River (1980/81).

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TABLE 4 Mean and range for seasonal benthic primary productivity in the South Saskatchewan River Basin (1980/81)

SITE LOCATION	mg CARBON$\cdot$m$^{-2}\cdot$h^{-1} MEAN	RANGE	SEASON HIGHEST	LOWEST
BOW RIVER				
1. Upstream of Calgary	35	10- 78	Sum/80	Fall/81
2. Downstream of Calgary	74	35-228	Fall/80	Sum/80*
5. Carseland	179	38-583	Sum/80	Fall/81
6. Downstream of Bassano Dam	50	5- 92	Sum/80	Win/80*
13. Bow City	63	4-258	Sum/80	Win/80
7. Ronalane Bridge	61	1-266	Sum/80	Fall/81
OLDMAN RIVER				
3. Upstream of Lethbridge	40	1-162	Sum/80	Win/80
4. Downstream of Lethbridge	105	1-394	Sum/80	Fall/81
8. Confluence with Bow	34	1-120	Sum/80	Fall/81
SOUTH SASKATCHEWAN RIVER				
9. Bow Island	83	11-255	Sum/80	Fall/81
10. Upstream of Medicine Hat	57	13-120	Spr/80	Spr/81*
11. Downstream of Medicine Hat	66	57- 81	Sum/80/81	Fall/81*
12. Highway 41	30	12- 41	Sum/81	Win/80*

* Data Incomplete
Spr = Spring - 20 February/19 June
Sum = Summer - 20 June/14 September
Fall - 15 September/1 December
Win = Winter - 2 December/19 March

abundant. Production at Site 5 was highest and ranged seasonally from 38 to 583 mg carbon•m^{-2}•h^{-1} (Table 4). The seasonal pattern of benthic production was similar at Sites 5, 6, 13 and 7. At these sites, ^{14}C uptake was highest during summer and lowest during fall (Sites 5, 7) or winter (Sites 6, 13). The seasonal range of ^{14}C uptake was lowest at Site 6; however, this could be expected to result from the highly variable nature of discharge below the Bassano Dam.

3.3.2 The Oldman River

Productivity was similarly higher in the Oldman River during 1980 than 1981. Table 4 illustrates the seasonal mean and range of benthic algal primary productivity.

Although productivity among the Oldman River sites was not significantly different there was evidence of higher ^{14}C uptake downstream of Lethbridge (Site 4, Figure 10). At Site 4, ^{14}C uptake reached a peak of 421 mg carbon•m^{-2}•h^{-1} during August 15, 1980. The seasonal mean and range of production was also two-fold higher at Site 4 than either Site 3 or Site 8 (Table 4). Similar seasonal patterns evident throughout the Oldman River were characterized by summer maxima, a winter minimum at Site 3 and fall minima at Sites 4 and 8 during 1981.

3.3.3 The South Saskatchewan River

The temporal pattern of benthic algal primary productivity in the South Saskatchewan River is illustrated in Figure 11. Table 4 illustrates the mean and range of seasonal production.

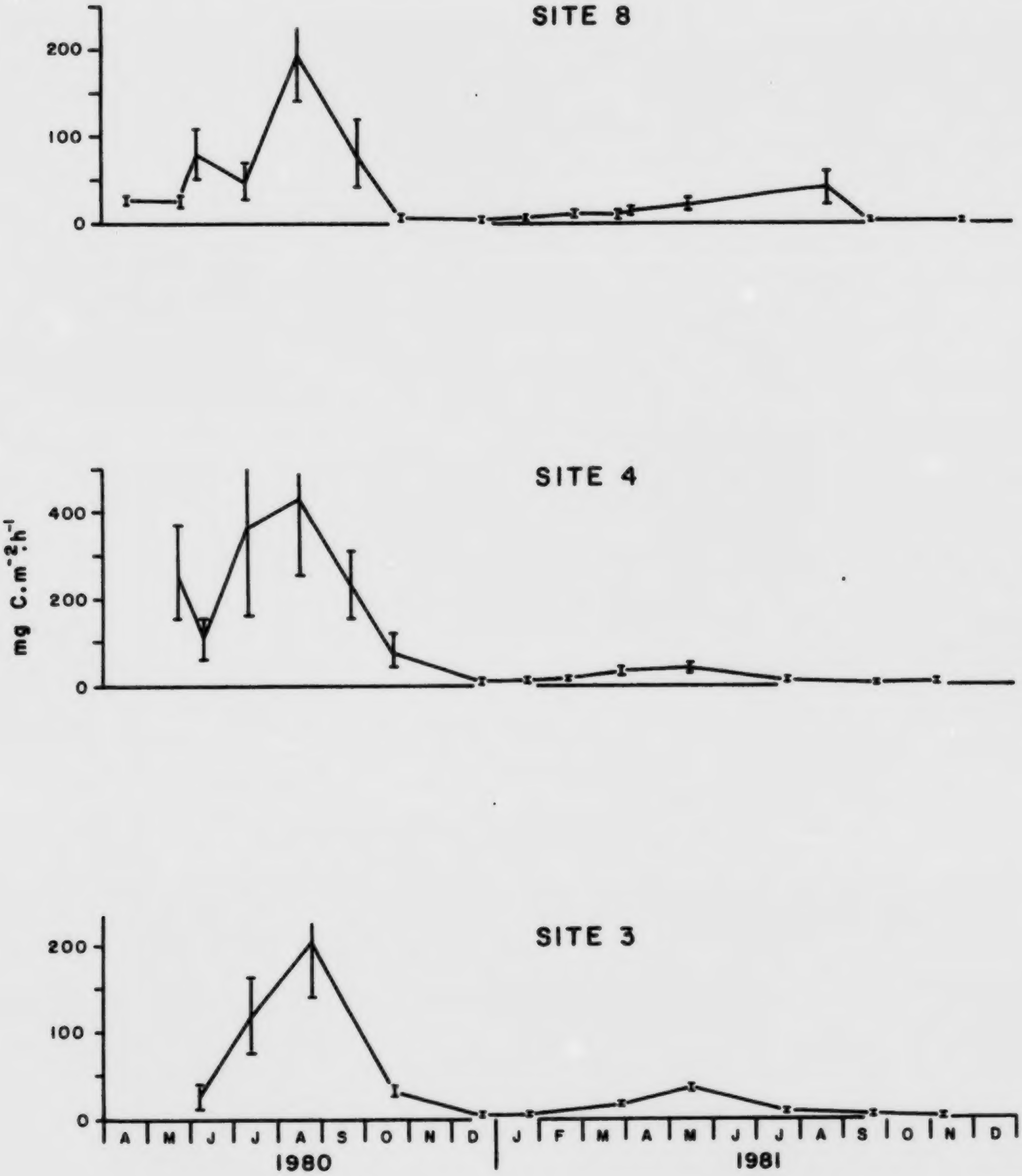

Figure 10. Mean epilithic algal primary productivity (mg Carbon·m^{-2}·h^{-1}) and 95% confidence limits for the Oldman River (1980/81).

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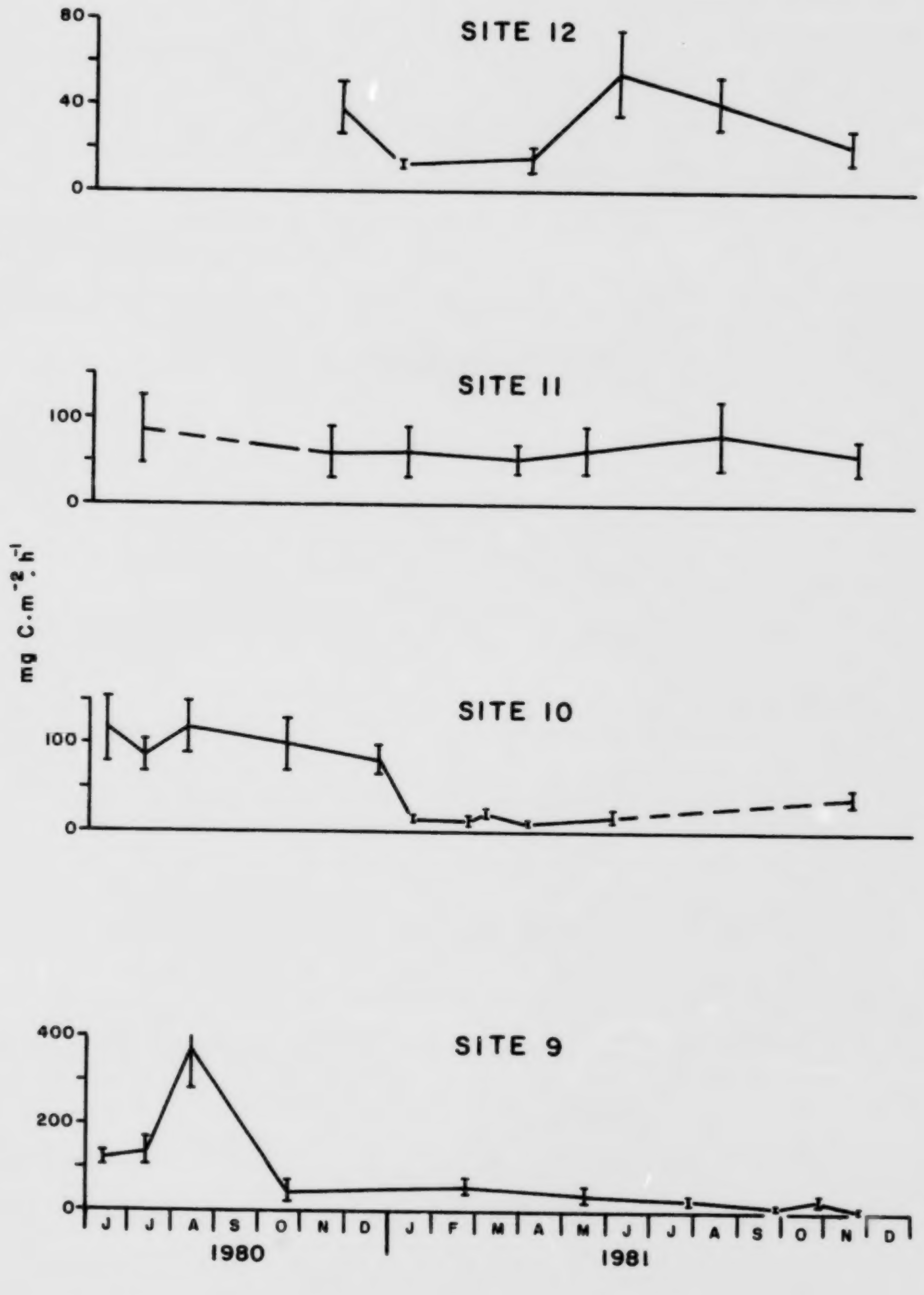

Figure 11. Mean epilithic algal primary productivity (mg Carbon $\cdot m^{-2} \cdot h^{-1}$) and 95% confidence limits for the South Saskatchewan River (1980/81).

Primary productivity averaged highest seasonally at Site 9 and lowest seasonally at Site 12 near the Alberta/Saskatchewan border. Productivity in the South Saskatchewan River was also higher during 1980, as was the case in the Bow and Oldman rivers. Productivity (seasonal) was significantly different (P = .01) between Sites 11 and 12 only. Benthic algal ^{14}C uptake was often higher during the summer in this river except at Site 10 where spring production (1980) was highest (Table 4). The seasons with the lowest productivity included fall at Sites 9 and 11, spring (1981) at Site 10 and winter at Site 12.

3.3.4 Summary

Throughout the study area benthic algal productivity, therefore, proved to be maximum during the summer season in the lower Bow River (Sites 5, 6, 13 and 7) and the entire Oldman and South Saskatchewan rivers except for Site 10 (upstream of Medicine Hat). Productivity was higher throughout the basin during 1980 than it was in 1981. 1981 was a high flow year (Cross et al. 1986). Both benthic productivity and algal standing crops were highest below major urban centres on the Bow and Oldman rivers. These values were particularly high downstream of Calgary. Conversely, in the South Saskatchewan River, epilithic productivity was highest (Site 9) upstream of the only urban centre, Medicine Hat. This site, however, represents the combined effects of the Bow and Oldman river waters.

3.4 River Course Helicopter Surveys

Because data derived from the studies on the Bow, Oldman and South Saskatchewan rivers were derived from information obtained on different sampling dates, the data are not directly comparable. In order to overcome this problem and facilitate comparison of the three rivers, river course surveys were conducted during early and late summer of 1980 and 1981. The entire river length within the study area was sampled during one day for quantification of its physicochemical and biotic characteristics.

3.4.1 The Bow River

During July and September of 1980 and 1981, eleven sites were sampled from the Bow River headwaters to its confluence with the Oldman River. Table 5 provides the location and a description of each site. Site numbers assigned during the river course helicopter survey represent locations that are independent of routine study site locations. Figure 1 illustrates the location of these sites.

The Bow River ranges from swiftly-flowing oligotrophic water at its headwaters in the Rocky Mountains to a eutrophic slow-flowing stream in its middle and lower reaches. Moreover, the Bow River is regulated by a series of inflowing rivers, dams and reservoirs which dampen the impact of spring high waters.

Although river course surveys were conducted in early July following the spring high water, and in late August of each year, similar patterns were observed with respect to physicochemical and algal parameters. Detailed interpretation of the river course physicochemical characteristics of the Bow appear in Cross et al., 1986. Figure 12 illustrates the river course values for algal standing crops, dissolved nitrogen (DN) and dissolved phosphorus (DP) in the Bow River.

TABLE 5. A BRIEF DESCRIPTION OF EACH SAMPLING SITE FOR THE BOW RIVER COURSE SURVEYS BY HELICOPTER.

Bow River - Site #	Brief Description
H1	Latitude 51° 10' 00"N, Longitude 115° 39' 25"W. Located immediately upstream of Banff, Alberta at 4500'(1372m) altitude - river banks range from 0 to 1 metre high, the river is swift and riffled. River substrate ranges from flat stone to cobble,with substantial quantities of sediment visible on the river substrate
H2	Latitude 51° 10' 7"N Longitude 114° 52' 40"W Morley, located at 4000'(1220m) altitude - river banks sloped from a height of 5 metres. Flat stone and sediment covered the rocks for a distance of 2 metres from the shoreline out into the river.
H3	Latitude 51° 06' 20"N Longitude 114° 15' 45"W Between Sites 2 and 3 - the river receives water retained by the Ghost Dam, as well as effluent from settling ponds in the vicinity of Cochrane. Algae and macrophytes contributed 80 to 100% sub-strate coverage in the river (visual) in this area. Site 3, at Bowness, is an island in the middle of the river. River site is bounded by steep banks (north) and retention walls (stone) at Bowness Park. Substrate - cobble to flat stone.
H4	Latitude 51° 02' 30"N Longitude 114° 00' 50"W Downstream of the Elbow tributary - at Fort Calgary - flat stone and cobble substrate noticeable, encrusted with fungi and carbonates. River banks steep to a height of 2 metres.
H5	Latitude 50° 53' 50"N Longitude 114° 00' 12"W At Fish Creek Park - cobble, substrate, aquatic mosses. *Fontinalis* and algae particularly abundant. River shallow and riffled with steep banks to a height of 1.5 metres.
H6	Latitude 50° 48' 50"N Longitude 113° 43' 45"W Below the influences of the Sheep-Highwood Tributaries- macroalgae particularly abundant over cobble. River banks range from 1 to 15 metres in height, with an extensive flood plain utilized for farming (cattle pasture)
H7	Latitude 50° 47' 30"N Longitude 112° 52' 50"W Cluny - river deepens in this region with increasingly steep banks to a height of 5 metres in some areas. River substrate is predominantly cobble and silty mud in the littoral regions. Water is rapid and riffled.
H8	Latitude 50° 44' 52"N Longitude 112° 31' 27"W Below Bassano Dam - subject to highly variable discharges. Substrate ranges from flat stone to cobble and supports substantial growths of macroalgae. This site is a popular fishing area.
H9	Latitude 50° 25' 55"N Longitude 112° 13' 19"W Bow City Bridge - river shallow and macroalgae abundant. Macrophytes abundant, the site of previous fish kills during mid-summer. Cobble dominates the substrate with substantial deposits of silty mud in the littoral region.
H10	Latitude 50° 02' 39"N Longitude 111° 41' 25"W Ronalane Bridge - shallow, swiftly flowing water over cobble. Macroalgae and drifting plant material frequently observed.
H11	Latitude 49° 56' 04"N Longitude 111° 41' 25"W Confluence - water slow flowing over cobble and flat stone. Silty sediment covering the substrate, particularly in the littoral zone. Drifting plant material observed often

*H - helicopter longitudinal survey sites.

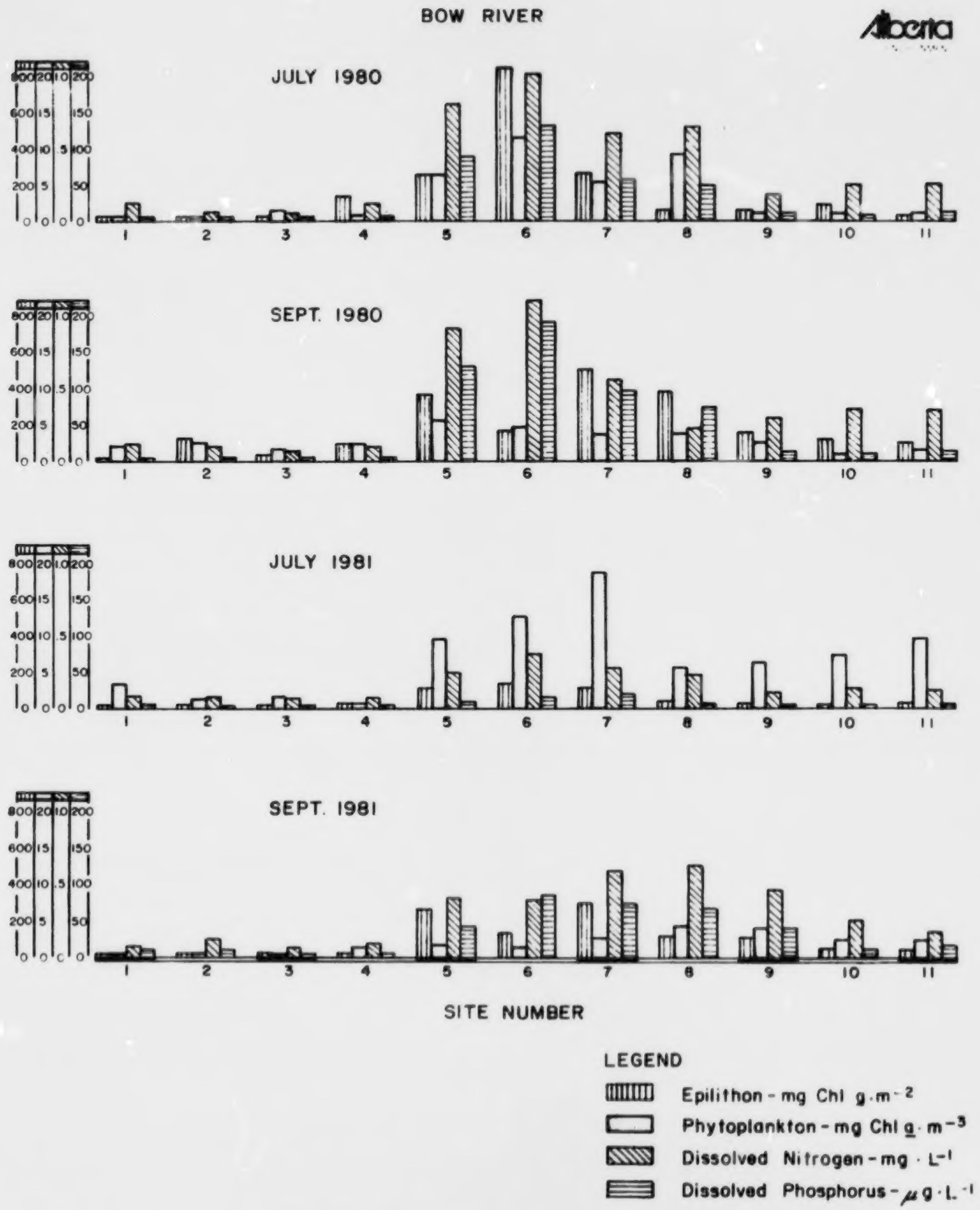

Figure 12. River course variation of algal standing crops, dissolved nitrogen and dissolved phosphorus from the Bow River headwaters (Site 1) to it's confluence with the Oldman River (Site 11).

Algal standing crops (epilithon) were higher during 1980 than 1981 throughout the Bow River; in each year September crops were higher than July crops (Figure 12). The average benthic algal standing crops for the entire river length were 164 mg chlorophyll $\underline{a}\bullet m^{-2}$ (July 1980), 44 mg chlorophyll $\underline{a}\bullet m^{-2}$ (July 1981), 191 mg chlorophyll $\underline{a}\bullet m^{-2}$ (September 1980), and 100 mg chlorophyll $\underline{a}\bullet m^{-2}$ (August 1981). The highest recorded level of epilithic standing crop for the entire Bow River was 833 mg chlorophyll $\underline{a}\bullet m^{-2}$ (July 1980) at Site 6, located below the Highwood River confluence with the Bow. This site frequently supported more algae than any other area of the Bow River. Moreover, the concentrations of essential nutrients (dissolved nitrogen, dissolved phosphorus) were high. During September, 1980, dissolved phosphorus concentrations were 0.190 $mg\bullet L^{-1}$ at Site 6 and dissolved nitrogen values were 1.100 $mg\bullet L^{-1}$. Phytoplankton standing crops were also highest at this site, possibly because of losses from the benthic community.

The river course helicopter survey provided evidence that algal standing crops and nutrients were indeed highest for that reach of the Bow River located between sites downstream of Calgary and Cluny (Site 7). This is the middle reach of the Bow River (Figure 12).

River course one-day surveys of the Bow River provided the unique opportunity for an overview of river conditions devoid of temporal effects. Regression analyses were further employed (SPSS) to define numerically the correlation between algal standing crop and specific nutrients as well as physical variables.

During July and September, 1980, ortho phosphorus accounted for 85% and 35% of the variation in epilithic algal standing crop, respectively (Table 6). During 1981, however, dissolved nitrogen was the primary variable which was highly correlated with benthic algal standing crops. Dissolved nitrogen accounted for 83% and 58% of the variation during July and September, respectively.

Phytoplankton standing crops were highly correlated with nitrate-nitrite nitrogen during July 1980 (r^2 = 93%) and September (r^2 = 70%). However, in 1981, dissolved nitrogen (r^2 = 86%) and silica (r^2 = 63%) were most highly correlated with phytoplankton standing crops.

Both early summer and late summer data from the Bow River river course surveys (1980/81) were combined and subjected to linear regression analysis. This was done in order to define the primary variable most highly correlated with algal standing crops. (The variables are listed in Table 6). Orthophosphorus (OP) was most highly correlated with benthic standing crops, while dissolved inorganic carbon (DIC) in July, and dissolved nitrogen (DN) in August/September, were most highly correlated with phytoplankton. These findings suggest that phosphorus, the principal biotic nutrient, profoundly influences the primary producer standing crop of benthic algae. Phytoplankton (senescent and drifting benthic forms) is less well defined with respect to the relationship between its abundance and nutrients or physical factors.

TABLE 6 Correlations between epilithic and planktonic standing crop (dependent) and various physiochemical variables (independent) for July and August/September river course surveys.

COMMUNITY	EPI	PHY	EPI	PHY	EPI	PHY	EPI	PHY
	July '80		Sept. '80		July '81		Sept. '81	
BOW RIVER								
* Parameter	OP	N	OP	N	DN	DP	DN	Si
Multiple r	.922	.964	.595	.836	.910	.928	.764	.795
(r^2)	85%	93%	35%	70%	83%	86%	58%	63%
OLDMAN RIVER								
* Parameter	pH	Turb	DP	DN	NFR	Si	N	DN
Multiple r	.872	.737	.936	.826	.755	.953	.826	.902
(r^2)	76%	54%	88%	68%	57%	91%	68%	81%
SOUTH SASKATCHEWAN RIVER								
* Parameter	Depth	NFR	NFR	pH	DN	Si	DP	N
Multiple r	.568	.858	.633	.817	.581	.747	.856	.511
(r^2)	32%	74%	40%	67%	34%	56%	75%	26%

COMBINED	EPILITHON			PHYTOPLANKTON		
	BOW	OLDMAN	SSR	BOW	OLDMAN	SSR
(July 1981/82)						
* Parameter	OP	OP	DIC	DIC	Temp	Si
Multiple r	.926	.836	.577	.615	.685	.842
(r^2)	86%	70%	33%	38%	47%	71%
(September 1981/82)						
* Parameter	OP	DP	N	DN	DN	DOC
Multiple r	.634	.729	.599	.775	.832	.728
(r^2)	40%	53%	36%	60%	69%	53%

ALL RIVERS	EPILITHON	PHYTOPLANKTON
(1980)		
* Parameter	DP	DN
Multiple r	.769	.652
(r^2)	59%	43%
(1981)		
* Parameter	DN	NFR
Multiple r	.726	.444
(r^2)	53%	20%

* Parameter most highly correlated with algal standing crop.
EPI = Epilithic, PHY = Planktonic, OP = Orthophosphorus,
N = Nitrate, DN = Dissolved Nitrogen, DP = Dissolved Phosphorus,
NFR = Non-filterable Residue, Si = Silica, DOC = Dissolved
Organic Carbon, DIC = Dissolved Inorganic Carbon

3.4.2 The Oldman River Course Survey

One-day river course surveys were performed on the Oldman River to discern its physicochemical and biotic characteristics during 1980 and 1981. Table 7 presents a general description and the location of each sampling site. The physicochemical characteristics were presented in Cross *et al*. (1986). Figure 13 illustrates the abundance of algae (epilithic, phytoplankton) as well as nutrients (dissolved nitrogen, dissolved phosphorus).

Algal standing crops for the entire Oldman River length were lower during 1981 than 1980. Moreover, standing crops were lower during July than September for both 1980 and 1981. During 1980, benthic algal standing crop averaged 50 mg chlorophyll $\underline{a}\bullet m^{-2}$ in July and 150 mg chlorophyll $\underline{a}\bullet m^{-2}$ in September.

In 1981 benthic algal standing crop averaged 15 mg chlorophyll $\underline{a}\bullet m^{-2}$ for July and 73 mg chlorophyll $\underline{a}\bullet m^{-2}$ during early September (Figure 13). Site 7, located downstream of Lethbridge, frequently supported the highest epilithic standing crop and Site 5 supported the lowest. The exception was during July 1980 when Site 1 had the lowest benthic standing crop. Phytoplankton standing crops averaged 2.36 mg chlorophyll $\underline{a}\bullet m^{-3}$ for all surveys. Standing crops were generally higher within the slow-flowing, deeper reaches of the Oldman River downstream of Site 7.

Linear regression analyses (SPSS) were performed to discern the principal factor most highly correlated with algal standing crops (Table 6). In the Oldman River, pH and dissolved phosphorus were highly correlated with epilithic standing crop during 1980. In 1981 weaker correlations were observed between epilithic standing crop

TABLE 7. DESCRIPTION AND LOCATION OF OLDMAN RIVER COURSE HELICOPTER SURVEY SITES.

OLDMAN RIVER - SITE #	BRIEF DESCRIPTION
H1 -	Latitude 50° 00' 00"N Longitude 114° 31' 15"W East of Mount Tyndall - river rapid and riffled. Algae sparse during July, more abundant during late summer. No evidence of macrophytes. River banks various, with substantial amounts of conifers adjacent to the river. This site is relatively unaffected by human activities.
H2 -	Latitude 49° 47' 50"N Longitude 114° 09' 30"W Below Callum Creek - river rapid over cobble and boulder substrate. Macroalgae abundant, particularly *Nostoc sp.* River banks steep and subject to slumping - height of 30 metres.
H3 -	Latitude 49° 33' 30"N Longitude 113° 09' 45"W Brocket - steep banks up to 30 metres high, slumping evident. Sand banks and cobble substrate contribute to increasing suspended sediment load in the river. Evidence of cattle farming river use and water removal for irrigation purposes.
H4 -	Latitude 49° 46' 42"N Longitude 113° 19' 40"W Pearce, downstream of Willow Creek - river is shallow over cobble and shore stone. Macroalgae noted downstream of Fort Macleod, perhaps caused by domestic influence.
H5 -	Latitude 49° 45' 50"N Longitude 113° 01' 15"W Coalhurst - Kipp area - cobble substrate covered by sediment. Some evidence of disturbance caused by gravel operations in the vicinity of the river.
H6 -	Latitude 49° 38' 5"N Longitude 112° 51' 55"W Above Lethbridge - river shallow, riffled over cobble and flatstone. River banks steep and subject to slumping.
H7 -	Latitude 49° 47' 03"N Longitude 112° 49' 58"W Diamond City, downstream of Lethbridge, extensive macroalgal development on cobble and flat stone, in the midstream only.
H8 -	Latitude 49° 51' 55"N Longitude 112° 26' 30"W Downstream of Little Bow River - river banks are various from vertical to 4 metres on north bank. Macroalgae patchy over cobble.
H9 -	Latitude 49° 55' 25"N Longitude 112° 57' 05"W Located due north of Purple Springs - the river banks in this area very steep to 50 metres. The river swift over cobble. Macroalgae patchy.
H10 -	Latitude 49° 56' 02"N Longitude 111° 41' 48"W Confluence - water slow flowing, high in suspended sediment. Cobble substrate covered by silty mud. Drifting macroalgae observed.

* H denotes longitudinal helicopter survey sites

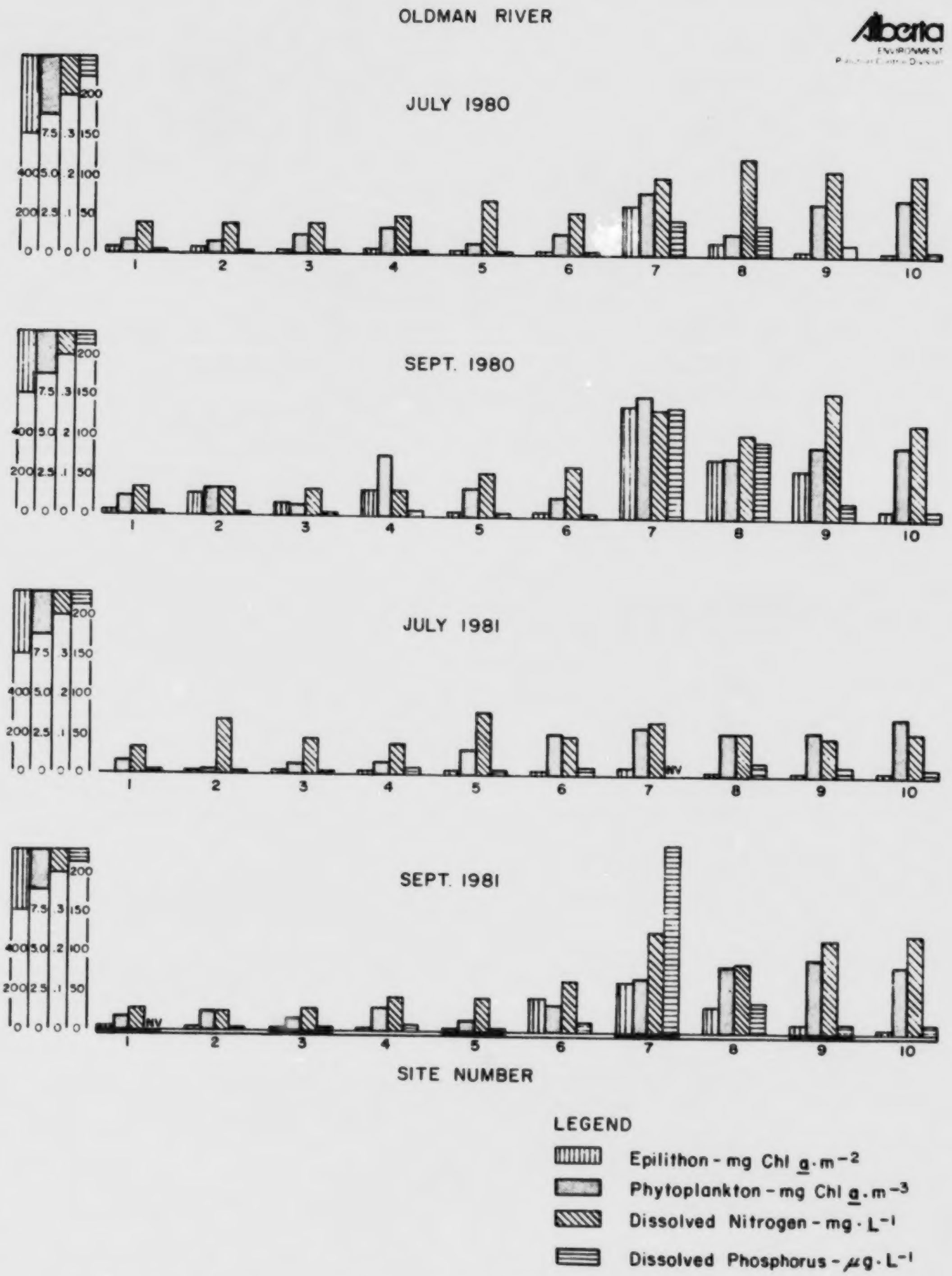

Figure 13. River course variation of algal standing crops, dissolved nitrogen and dissolved phosphorus from the Oldman River headwaters (Site 1) to it's confluence with the Bow and South Saskatchewan Rivers (Site 10).

and non-filterable residue (NFR) and nitrate. Turbidity, dissolved nitrogen and silica correlated best with phytoplankton (Table 6). However, when July data and September data were combined, phosphorus (OP and DP) was most highly correlated with epilithic algal standing crops in similarity to the Bow River (Table 6). Phytoplankton standing crops were most highly correlated with temperature for the July surveys and in similarity to the Bow, with dissolved nitrogen during the September surveys.

3.4.3 The South Saskatchewan River

The South Saskatchewan River was surveyed during 1980 and 1981 and sampled at nine sites from its origin at the confluence of the Bow and Oldman rivers to the confluence of the Red Deer River (Figure 1). This river is generally deeper than the other rivers and meanders slowly through dry prairie. Table 8 provides a description of each sample site.

Epilithic algal standing crops in the South Saskatchewan River were similar to those in the Bow and Oldman Rivers - higher during 1980 than 1981 (Figure 14). Data from surveys indicated that there were higher standing crops in September than there were in July. Benthic algal standing crops averaged 29 mg chlorophyll $\underline{a} \bullet m^{-2}$ in July and 55.4 mg chlorophyll $\underline{a} \bullet m^{-2}$ during September. Epilithic standing crops were lower in the South Saskatchewan River than in the Bow and Oldman Rivers. River course trends were not as evident in the South Saskatchewan River. During July and September of 1980, Site 8 supported the most benthic algae, and in 1981 Site 1 had the highest epilithic standing crop. Moreover, there was a decrease in benthic

TABLE 8: DESCRIPTION AND LOCATION OF SOUTH SASKATCHEWAN RIVER COURSE HELICOPTER SITES.

South Saskatchewan River - Site #	Brief Description
H1 -	Latitude 49° 55' 19"N Longitude 111° 41' 08"W Confluence of the Bow and Oldman Rivers - water riffled to slow flowing over flat stone and cobble.
H2 -	Latitude 49° 54' 15 N" Longitude 111° 28' 17"W Bow Island - current slow, river water high in suspended sediment. Sediment covering littoral cobble and flat stone. Drifting algae noted. Attached algae abundant.
H3 -	Latitude 50° 04' 03"N Longitude 111° 07' 25"W River swift meandering through a wide flood plain used for cattle pasture. River banks increasingly steep to 60 metres. Substrate cobble to boulders and gravel frequently visible.
H4 -	Latitude 50° 04' 03"N Longitude 110° 46' 40"W Above Medicine Hat - Potamogeton sp. particularly abundant. Flat stone cobble substrate with littoral deposition of sediment.
H5 -	Latitude 50° 08' 25"N Longitude 110° 34' 48"W Downstream of Medicine Hat - site particularly subject to extensive bank slumping. Fungi noted on the cobble to mud substrate. Macroalgae covered 40-100% of the substrate. Substrate notably high in organic matter, probably caused by domestic effluent from Medicine Hat.
H6 -	Latitude 50° 29' 28"N Longitude 110° 22' 55"W Due west of Red Deer Lake - cobble to sand formed the predominant substrate. River shallow, slow-flowing with patchy macro-algal development on the substrate.
H7 -	Latitude 50° 29' 28"N Longitude 110° 22' 55"W Due west of Hilda - steep solid banks up to 150 metres high. River riffling over boulders and cobble. Macroalgae patchy in this area.
H8 -	Latitude 50° 43' 52"N Longitude 110° 03' 20"W At McNeill - the river banks were gradual sloping up to 50 metres high. Macroalgae particularly abundant, as were clams and fish fry. Current here slow.
H9 -	Latitude 50° 54' 20"N Longitude 110° 05'W Upstream of the South Saskatchewan River confluence with the Red Deer River - river substrate cobble with no evidence of algae or macrophytes during July. Abundant Nostoc sp. during late August. River banks various and flood plain was used for cattle pasture.

* H Denotes longitudinal helicopter survey sites.

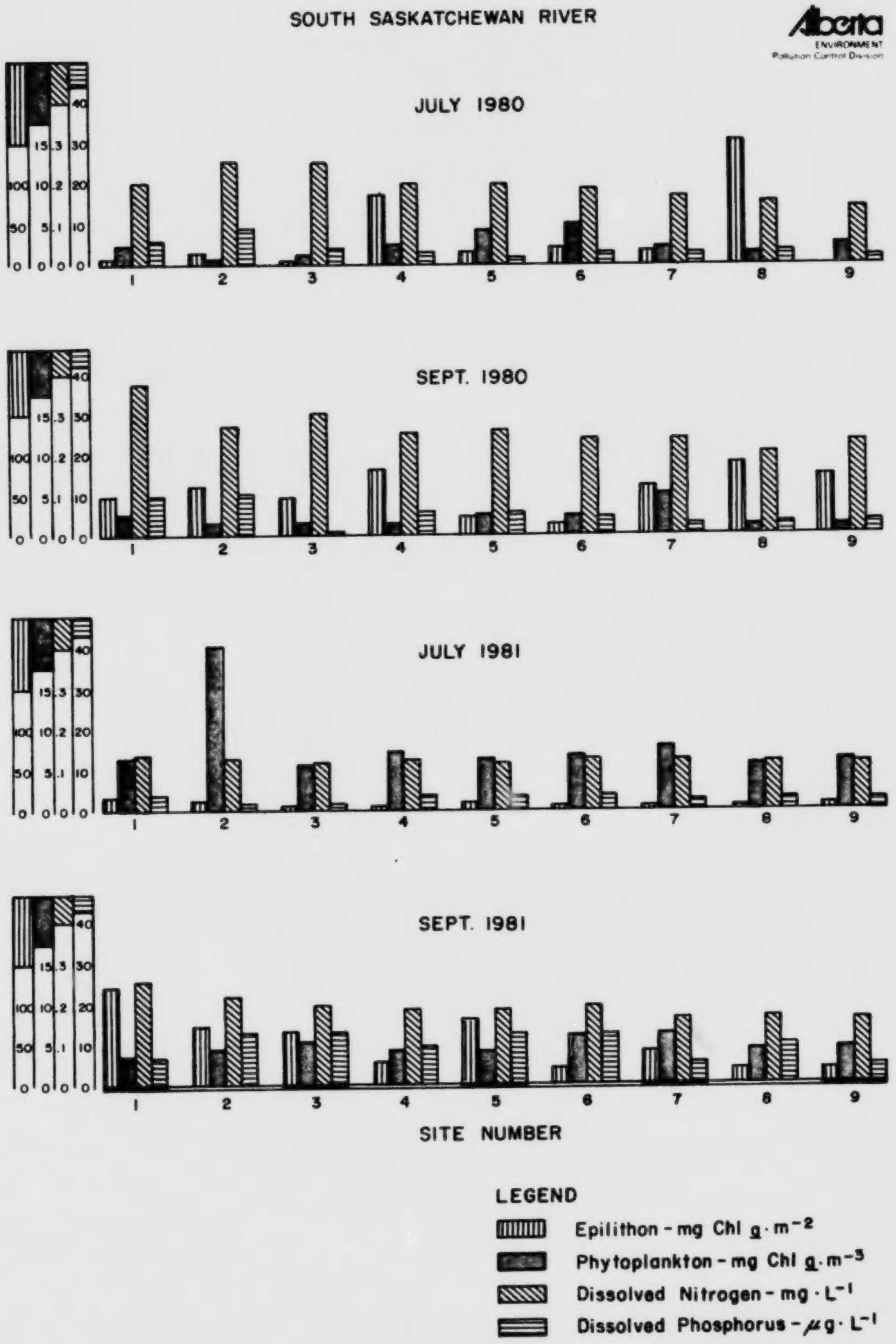

Figure 14. River course variation of algal standing crops, dissolved nitrogen and dissolved phosphorus from the origin of the South Saskatchewa River (Site 1) to it's confluence with the Red Deer River (Site 9).

standing crops in a downstream direction during 1981. Site 5 located downstream of Medicine Hat supported lower standing crops than Site 4 except during September, 1981.

Linear regression analyses (SPSS) were performed on data acquired during river course surveys of the South Saskatchewan River. Epilithic algal standing crops were most highly correlated with depth and non-filterable residue (NFR) during 1980, and with dissolved nitrogen and dissolved phosphorus during 1981 (Table 6). Phytoplankton standing crops correlated with a different parameter during each survey. Combined July data and September data indicated a high correlation between benthic standing crop and dissolved inorganic carbon (DIC) in July, and nitrate nitrogen in September. Phytoplankton standing crops were highly correlated statistically with silica levels during July and dissolved organic carbon (DOC) during September.

3.4.4 Summary

The river course helicopter survey data of the three rivers confirmed that epilithic algal standing crops were highly correlated with phosphorus and nitrogen, particularly in the Bow and Oldman rivers. Moreover higher standing crops occurred downstream of urban centres, specifically Calgary and Lethbridge. The origin of the South Saskatchewan River represents the convergence of waters from the Bow and Oldman Rivers. The convergence of these waters produced a chemical regime which stimulated algal growth. Therefore, standing crops were higher just below the convergence than those observed further downstream.

Annual survey data from the three rivers were combined to discern the primary variables that were highly correlated with algal standing crops for the South Saskatchewan River Basin. Linear regression analysis indicated that during 1980, epilithon was most highly correlated with dissolved phosphorus, and that phytoplankton was most highly correlated with dissolved nitrogen (Table 6). During 1981, dissolved nitrogen and non-filterable residue were the variables having the highest correlation with algal standing crop. Hence phosphorus and nitrogen were the variables that were most commonly correlated with benthic algal standing crop in the South Saskatchewan River Basin.

3.5 Phytoplankton Standing Crops and Productivity

3.5.1 The Bow River

Phytoplankton standing crops and productivity (^{14}C uptake) fluctuated widely throughout the Bow River. As they rarely paralleled each other, it is suggested that phytoplankton in the river may not be actively growing. In fact, microscopic examination of this community indicated the presence of predominantly senescent benthic forms. Other confirmation is that seasonal phytoplankton standing crops in the Bow River were low ranging from 1 to 21 mg chlorophyll $\underline{a}\bullet m^{-3}$ (Figure 15). The data in Table 9 indicate the mean standing crop and production for the Bow River during the 1980/81 investigative period.

Phytoplankton standing crops were seasonally higher at Site 13 and productivity was higher at Site 7. Phytoplankton standing crops at Site 13 were highest during the spring and summer, 1981.

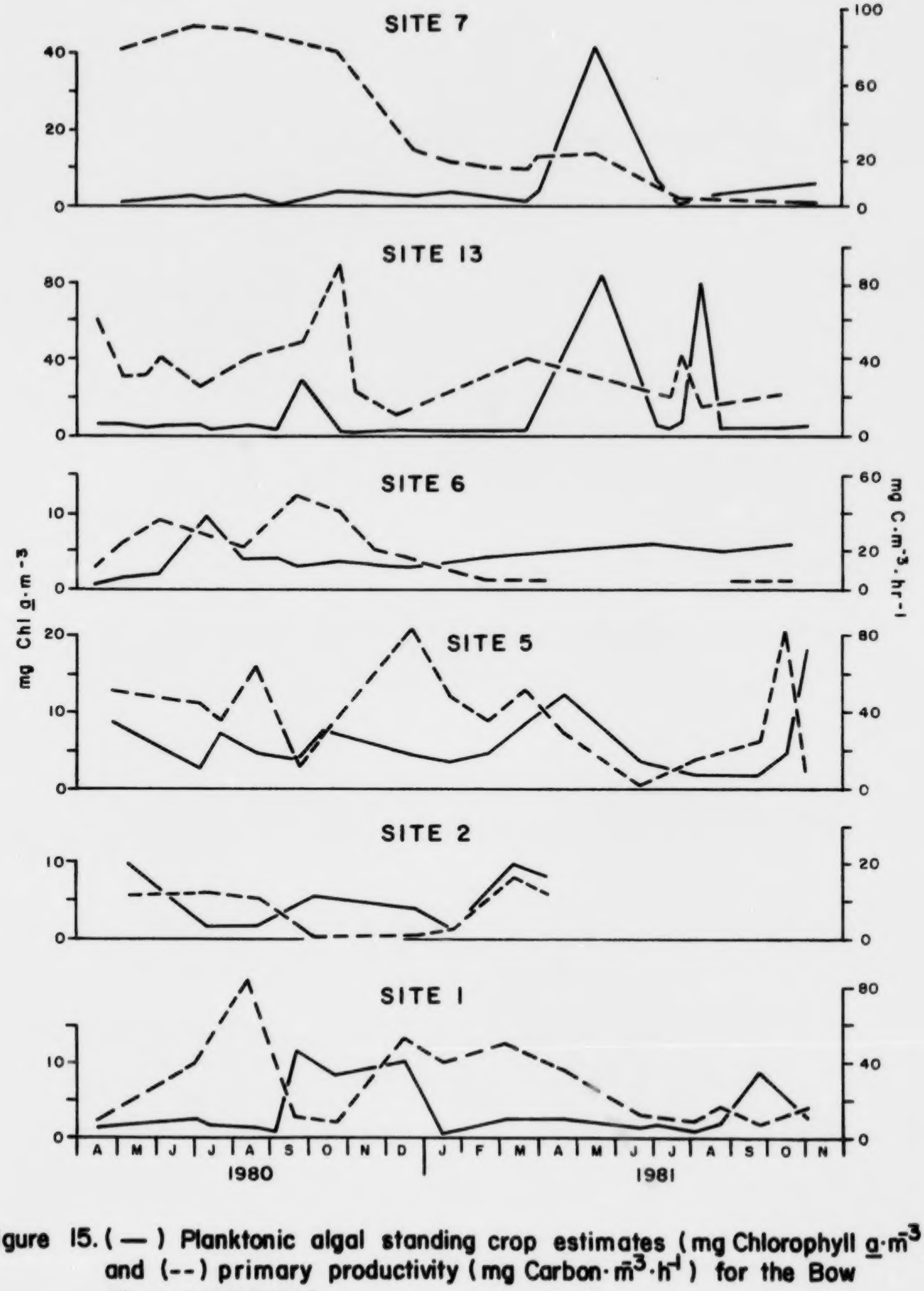

Figure 15. (—) Planktonic algal standing crop estimates (mg Chlorophyll $\underline{a}\cdot m^{-3}$) and (--) primary productivity (mg Carbon$\cdot m^{-3}\cdot h^{-1}$) for the Bow River (1980/81).

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TABLE 9 Seasonal mean and range of South Saskatchewan River Basin phytoplankton standing crop (chlorophyll $\underline{a}\cdot m^{-3}$) and productivity (mg carbon$\cdot m^{-3}\cdot h^{-1}$), 1980 and 1981.

	STANDING CROP		PRODUCTIVITY	
SITE/ LOCATION	MEAN	RANGE	MEAN	RANGE
	mg chlorophyll $\underline{a}\cdot m^{-3}$		mg Carbon$\cdot m^{-3}\cdot h^{-1}$	
BOW RIVER				
1. Upstream of Calgary	3	1- 10	28	9- 48
2. Downstream of Calgary	4	1- 8	9	1- 12
5. Carseland	6	3- 9	38	8- 56
6. Downstream Bassano Dam	4	1- 6	27	11- 42
13. Bow City	13	2-21	31	11- 54
7. Ronalane Bridge	5	1-16	41	2- 93
OLDMAN RIVER				
3. Upstream of Lethbridge	3	1- 4	31	7- 90
4. Downstream of Lethbridge	7	2-12	38	15- 70
8. Confluence with Bow	3	2- 5	37	9- 46
SOUTH SASKATCHEWAN RIVER				
9. Bow Island	6	2- 26	48	18-165
10. Upstream of Medicine Hat	3	2- 6	22	11- 48
11. Downstream of Medicine Hat	3	2- 3	28	21- 41
12. Highway 41	4	1- 14	25	2- 40

Phytoplankton ^{14}C uptake was highest during spring and summer, 1980. High productivity and low standing crops in the lower reach of the Bow River suggested higher planktonic efficiency in this reach, perhaps caused by the meandering, slow-flowing nature of the river. Average planktonic standing crops were the same for Site 2 and 6; however, productivity was much higher at Site 6 (Table 9). Therefore, phytoplankton populations downstream of Calgary (Site 2) consisted mainly of senescent algae while those that occurred further downstream were actively growing.

3.5.2 The Oldman River

In the Oldman River phytoplankton standing crops and productivity were more closely related than they were in the Bow River. Table 9 presents the seasonal means and ranges for standing crop and productivity in the Oldman River for 1980 and 1981.

Phytoplankton standing crops were highest during the summer and spring seasons of 1980 and 1981, respectively, at Site 3 (Figure 16). Phytoplankton ^{14}C uptake at Site 3 was highest during the fall/winter of 1980. Both standing crop and productivity (seasonal mean) were highest downstream of Lethbridge at Site 4 (Table 9). Values were higher during 1980 than they were in 1981. In 1980 the averages were 12.3 mg chlorophyll $\underline{a} \cdot m^{-3}$ and 69.8 mg carbon$\cdot m^{-3} \cdot h^{-1}$ during the fall (Sept. 15 - Dec. 1) season. At Site 8, phytoplankton standing crops for 1980 and 1981 had the same seasonal mean of 3 mg chlorophyll $\underline{a} \cdot m^{-3}$. However, ^{14}C uptake was higher (Table 9). Phytoplankton production at Site 8 was highest during the spring seasons of both 1980 and 1981 (Figure 16). The highest phytoplankton standing crop at Site 8 also occurred during spring, 1981 (Figure 16).

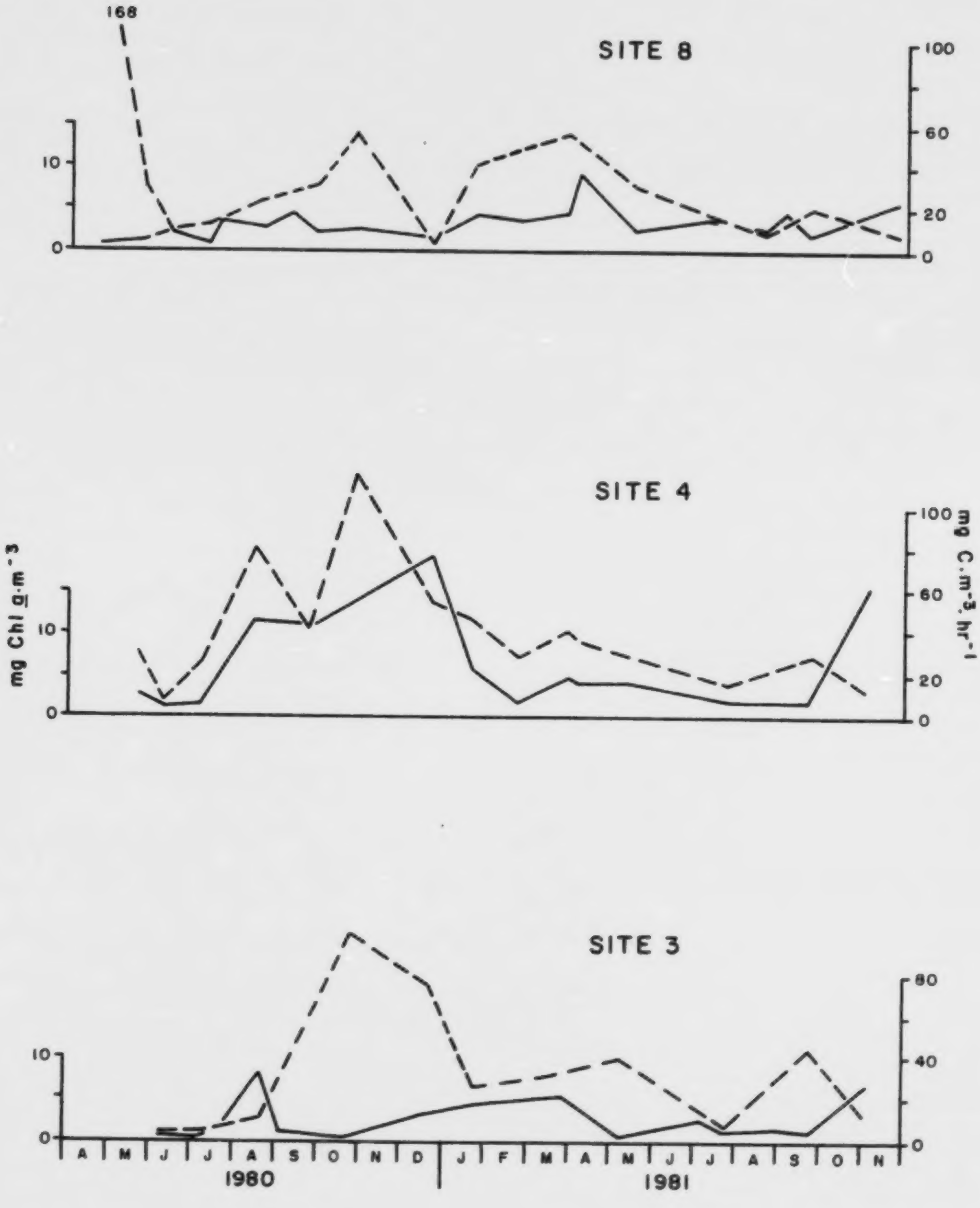

Figure 16. (—) Planktonic algal standing crop estimates (mg Chlorophyll a · m^{-3}) and (--) primary productivity (mg Carbon · m^{-3} · h^{-1}) for the Oldman River (1980/81).

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3.5.3 The South Saskatchewan River

Phytoplankton standing crops and productivity were frequently higher at the origin of the South Saskatchewan River (Site 9) than other sites downstream (Figure 17). The seasonal mean standing crop at Site 9 was 6 mg chlorophyll a•m^{-3} and productivity averaged 48 mg carbon•m^{-3}•h^{-1}. Table 9 presents mean seasonal values for all sites within the South Saskatchewan River.

At Site 10, located upstream of Medicine Hat, standing crop peaked during the fall of 1980 and summer of 1981 (Figure 17). Phytoplankton ^{14}C uptake reached a maximum of 48 mg carbon•m^{-3}•h^{-1} during the fall season (Sept. 15 - Dec. 1) of 1980. Although mean seasonal standing crops were the same for Sites 10 and 11, productivity was higher downstream of Medicine Hat (Site 11). Moreover the temporal variation of ^{14}C uptake and chlorophyll a showed little change. At Site 12, phytoplankton standing crop and productivity both peaked during the winter season (Dec. 2 - Mar. 19) and reached an average of 14 mg chlorophyll a•m^{-3} and 40 mg carbon•m^{-3} h^{-1}, respectively.

3.6 Comparison of the Rivers Within the Same Locale

The myriad of factors which control primary producers in the South Saskatchewan River Basin are indeed complex. Elimination of data variation attributed to temporal, climatic and topographic local factors was possible only at the confluence of the Bow and Oldman Rivers (Lat. 49°, 51', 02" N; Long. 111°, 41' 48" W).

Substrates in the three rivers at this location were similar as was local riparian (river bank) vegetation, soil and climate. As

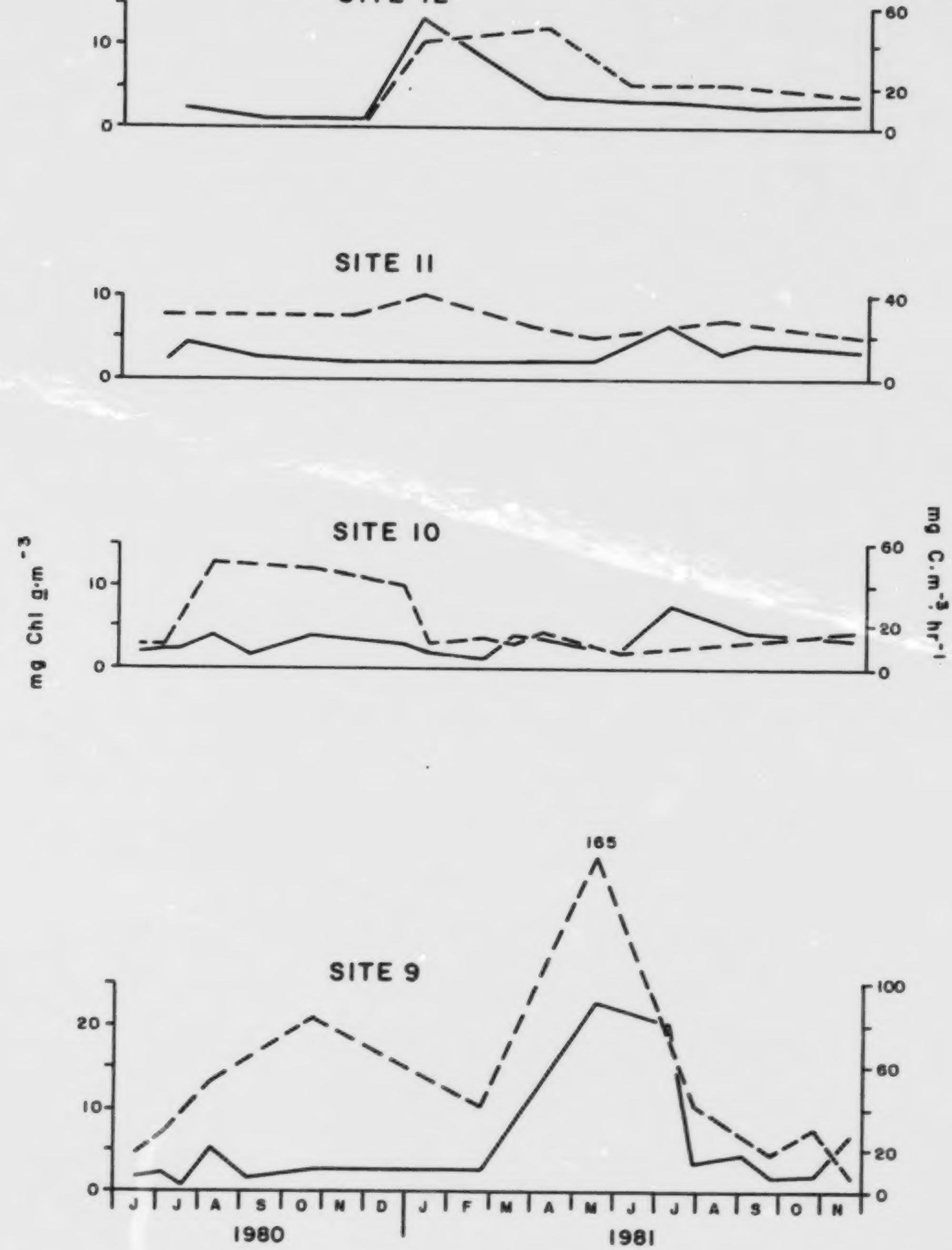

Figure 17. (—) Planktonic algal standing crop estimates (mg Chlorophyll a · m^{-3}) and (--) primary productivity (mg Carbon · m^{-3} · h^{-1}) for the South Saskatchewan River (1980 / 81).

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soil is fine grained clayey-sand, the river banks are particularly subject to erosion and slumping. Water samples were collected immediately upstream of the confluence of the Bow and Oldman rivers, and downstream from the origin of the South Saskatchewan River. Water samples were collected at mid-stream, and biota were collected along transects across each river. Table 10 indicates the biotic and physico chemical characteristics of the three rivers during the morning of September 30, 1980. These sites were at the confluence of the Bow and Oldman rivers and immediately downstream in the South Saskatchewan River.

As the Bow and Oldman rivers converge, they form the origin of the South Saskatchewan River. The concentration of most nutrients, with the exception of nitrate-nitrite nitrogen and reactive silica, were higher in the Bow River than in the Oldman River. The concentrations of dissolved phosphorus, dissolved nitrogen and chloride in the Bow River were diluted by the Oldman River water. Values for temperature, ortho phosphorus, total inorganic phosphorus, nitrate-nitrite nitrogen, particulate nitrogen, particulate organic carbon, dissolved inorganic carbon and reactive silica were the same or higher in the South Saskatchewan River as in the Oldman River. The Oldman River water was more turbid, because of the presence of suspended sediment, than the Bow River. The combined effect of these rivers however, yielded an even higher turbidity value for the South Saskatchewan River (Table 10). Raised turbidity may also be related to inputs that occurred between the Bow, Oldman and South Saskatchewan River sampling sites.

TABLE 10 The physicochemical and biotic characteristics of the Bow, Oldman and South Saskatchewan Rivers at their confluence (Sept. 30, 1980)

		RIVERS	
	BOW	OLDMAN	S. SASK
Specific Conductance (mmhos cm^{-2})	373.0	429.0	425.0
Turbidity (J.T.U.)	3.9	6.8	9.2
pH (pH units)	8.00	8.15	8.05
Total Alkalinity (meq"L^{-1})	1.95	2.42	2.33
Temperature (°C)	13.3	13.2	13.2
Total phosphorus as P	0.021	0.062	0.058
Dissolved phosphorus	0.010	0.027	0.033
Dissolved inorganic phosphorus	0.003	0.016	0.010
Ortho phosphorus	0.003	0.003	0.004
Total inorganic phosphorus	0.010	0.031	0.044
Nitrate/nitrite nitrogen	0.07	0.01	0.01
Dissolved Nitrogen	0.35	0.38	0.20
Particulate Nitrogen	0.14	0.15	0.24
Particulate Organic Carbon	0.67	0.91	1.2
Dissolved Inorganic Carbon	26.0	32.0	32.0
Chloride (Dissolved)	4.1	4.2	4.0
Reactive silica	0.4	0.2	0.6
Chlorophyll			
Planktonic (mg"m^{-3})	5.6 % 2.7	18.9 % 5.8	12.9 % 3.2
Epilithic (mg"m^{-2})	122.5 % 103	39.3 % 27	148.3 % 116
Primary Productivity			
Planktonic (mg carbon"m^{-3}"h^{-1})	62.8	31.3	94.3
Epilithic (mg carbon"m^{-2}"h^{-1})	123.8 % 56	78.5 % 41	214.7 % 44
Photosynthetic Index			
Planktonic (mg C"mg chl a"m^{-3}"h^{-1})	11.21	1.66	7.31
Epilithic (mg C"mg chl a"m^{-2}"h^{-1})	1.01	2.00	1.45
Depth (cm)	40.0	40.0	40.0
Insolation (MJ"m^{-2}"h^{-1})	1.02	1.02	1.02
Discharge (m^{3}"s^{-1})	40.5	47.8	92.4

* All values above mg•L^{-1} units except otherwise noted.

Planktonic algal standing crops were found to be highest in the Oldman River, possibly because of its slow meandering nature and the presence of numerous quiet water areas. Epilithic standing crops were lowest in the Oldman River, however, possibly because of sediment accumulation over the rock substrate. The South Saskatchewan River also had the highest epilithic algal standing crop and the highest productivity. Therefore, it appears that the synergistic effects of Bow and Oldman river waters stimulated epilithic algal growth and development at the origin of the South Saskatchewan River.

The algal photosynthetic index (efficiency) for the study date was highest in the Bow River phytoplankton community and highest in the Oldman epilithic community. This means that the Oldman River supported an actively growing epilithic community of small (low chlorophyll a content) cells which were very efficient.

3.7 Diurnal Productivity (The Bow River)

Primary producer productivity varied not only seasonally but daily in response to the increase and decrease of sunlight. The diurnal variation of chemical parameters in the Bow River was presented in Cross et al. (1986). Figure 18 presents the diurnal variation of productivity, pH, temperature and bicarbonate alkalinity for the Bow River during the period October 15 and 16, 1981, at Site 5 (Carseland).

Epilithic primary productivity on October 15-16 was highest during the period 10:00 through 14:00 hours Mountain Standard Time (Figure 18). Thereafter ^{14}C uptake declined to a minimum for the

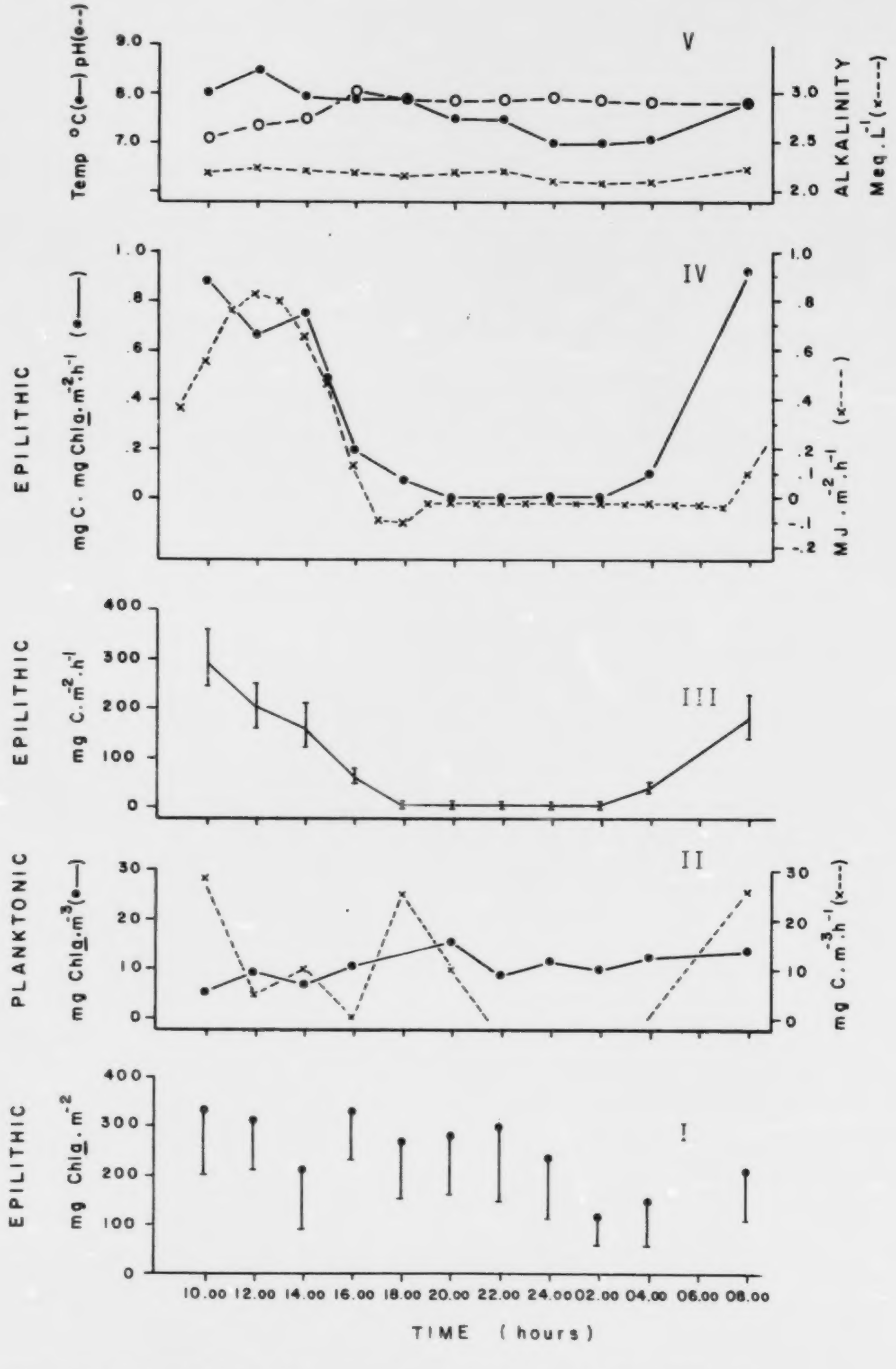

Figure 18. Diurnal variation measurements at Site R5 of :
I. Epilithic Chlorophyll a
II. Planktonic Chlorophyll a
III. Epilithic primary productivity
IV. Epilithic photosynthetic efficiency
V. pH, temperature, and bicarbonate alkalinity

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dark period (18:00-02:00 hours). After 02:00 hours, productivity steadily increased to a midday maximum. Table 11 indicates the mean hourly rate of epilithic algal productivity.

Routine investigation of ^{14}C uptake was conducted hourly between 10:00 and 14:00 hours; therefore, the diurnal study provided some indication of the daily rate of ^{14}C uptake in relation to the entire 24 hour period. This investigation provided evidence for lower rates of ^{14}C uptake prior to and following routine studies (10:00-14:00 hours). Production occurring outside the 10:00 through 14:00 hour period amounted to an additional 55% (Table 11). During the dark period 20:00 through 04:00 hours, ^{14}C uptake represented less than 1% of the rate observed for 10:00 through 14:00 hours. Daily production for the Bow River during, October 15-16 was 432 mg carbon$\bullet m^{-2}\bullet day^{-1}$.

Mean hourly benthic algal productivity was highest during the period from 10:00 to 12:00 hours, then photosynthetic efficiency fell at 12:00 hours. This midday suppression coincided with the period of maximum net radiation (Figure 18).

Phytoplankton primary production peaked at 08:00, 10:00 and 18:00 hours, while standing crops (drift) were highest during the early evening (20:00 hours) (Figure 18). Bicarbonate alkalinity and pH changed little during the 24 hour period. Temperature peaked during midday.

3.8 Algal Standing Crop Heterogeneity

During the diurnal study, epilithic algal standing crop heterogeneity among 38 separate rocks was compared. Standing crop ranged from 43.6 to 581.1 mg chlorophyll $\underline{a}\bullet m^{-2}$ with a mean of 255.1 mg

TABLE 11 Epilithic ^{14}carbon uptake rates prior to and following a routine 10:00-14:00 hour incubation at Site 5 during October 15 and 16, 1981.

TIME	EPILITHIC ^{14}CARBON UPTAKE mg carbon$\cdot$m$^{-2}\cdot$h^{-1}	PERCENTAGE OF 10:00-14:00 HR. RATE
10:00-14:00	274.5	100 (4 hours)
14:00-20:00	112.3	41 (6 hours)
20:00-04:00	2.1	1 (8 hours)
04:00-10:00	36.0	13 (6 hours)

chlorophyll $\underline{a}\cdot m^{-2}$. Figure 18 presents the standing crop of each incubation series and the 95% confidence limit of the 9-12 rocks assayed during each successive incubation. Confidence limits were lower during the dark period when it was not possible to observe the rocks during collection. This deliberate lack of bias yielded a lower standing crop estimate.

For many reasons, it was also necessary to determine the sample size which yielded an adequate estimate of epilithic algal standing crop. Routine studies had consisted of 12 to 15 separate samples. It was not known however, how the standard error of this estimate compared for various sample sizes. Therefore, the standard error of the mean standing crops was calculated (S.E. = 14.2; n = 88) and compared to the standard error for increasing sample sizes. Table 12 depicts the results.

The standard error associated with 88 individual samples was nearly equal to that determined for 42 samples. Thus 42 samples would have yielded an adequate estimate of epilithic standing crop. Unfortunately it is not feasible to collect routinely 42 samples of standing crop. Routine assays of 12 to 15 samples were, however, feasible. Routine estimates of algal standing crop were found to represent a standard error approaching 35%.

Data gathered during this investigation confirmed the very patchy nature of epilithic algal standing crops in lotic systems such as the Bow River. Because of the high degree of variation, and the myriad of ecological factors which influence algal standing crop distribution and abundance, caution must be employed when interpreting and predicting from the data.

TABLE 12 The standard errors associated with various sample sizes for estimating attached algal standing crop in the Bow River, 1981

SAMPLE SIZE	S.E.
12	35.7
15	31.3
30	19.8
40	15.6
42	14.9
50	12.4
70	7.2

3.9 Macrophyte Species Composition

The distribution of aquatic submerged macrophytes range from extremely prolific (near Calgary) to patchy, or sparse, throughout the remainder of the South Saskatchewan River Basin. With the exception of downstream Calgary, the preferred macrophyte habitat was primarily quiet water areas where stream current is minimal, i.e., backwaters having silty substrate. Downstream of Calgary macrophytes occur in coarse gravel and cobble substrate in regions subjected to active currents. The dominant species found in the Bow River (1980) were _Zannichellia palustris_, _Potamogeton vaginatus_, _P. crispus_ and _P. pectinatus_. In addition, _P. richardsonii_ was observed only in Bassano Dam.

Figure 19 illustrates the general micro-distribution of macrophytes observed in the Bow River. _Z. palustris_ was located in nearshore regions on mud/gravel substrate. _P. pectinatus_ occurred in the deeper region where large cobble occurred. _P. vaginatus_ was dominant in the midstream among large cobble substrate. _P. crispus_ was found in a wider range of habitats and more frequently in areas sheltered from current effects. Bow River regions lacking _P. vaginatus_ were frequently devoid of any macrophyte growth, i.e., in mid-channel. _P. vaginatus_ was generally dominant between sites M2 and M8 while _P. pectinatus_ dominated between M9 and M12 during 1982 and 1983.

3.9.1 Macrophyte Growth Cycle

Submerged macrophytes in the Bow River are perennial. Growth during early May originated principally from rhizomes located in the

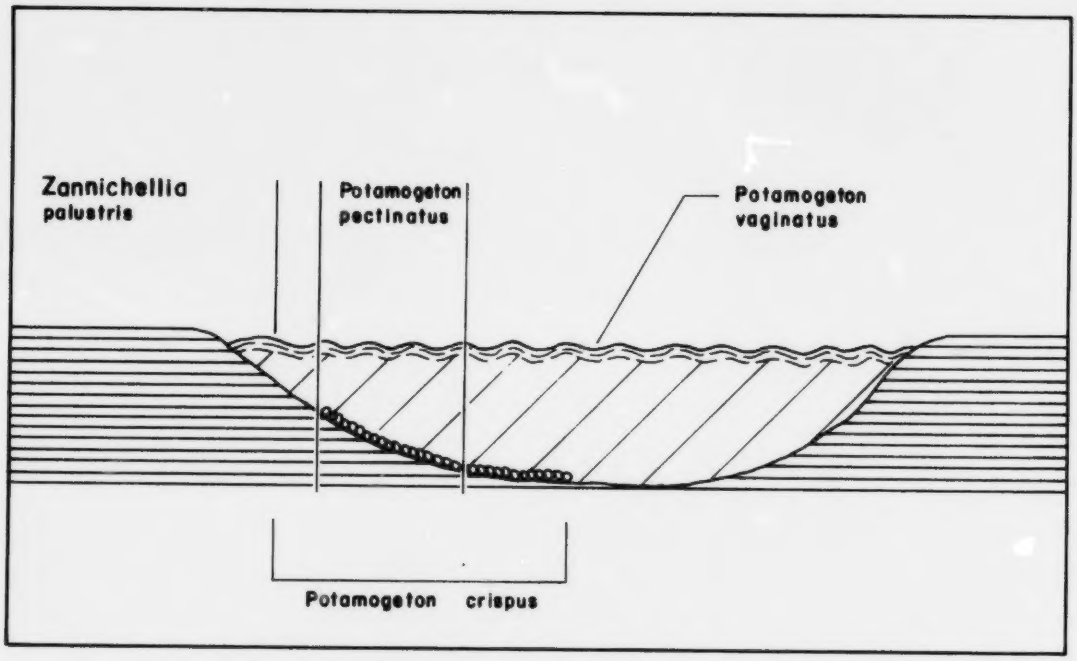
Zannichellia palustris
Potamogeton pectinatus
Potamogeton vaginatus
Potamogeton crispus

Figure 19. The micro-distribution of dominant macrophyte species in the Bow River downstream of Calgary.

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river substrate and continued until June when the mountain melt and resulting high river discharges normally scour away much of the photosynthetic plant tissue, and probably some substrate rhizomes. Immediately following the June high waters, macrophytes again grow and produce a peak biomass in late August or September of most years.

3.9.2 Benthic Algal/Macrophyte Biomass Ratios

Macrophyte and benthic algal biomass ratios were compared for 1981 and 1982. Data were collected at stations M1 (R and L) through M12 (R and L) (Table 13). Macrophyte dry weight was compared to benthic algal biomass by converting the chlorophyll a ($mg \cdot m^{-2}$) to dry weight (mg chlorophyll $a \cdot m^{-2} \times 50$)(Marker 1976). The ratios ranged from zero to a maximum of 28 at M5R during early July of 1981. Benthic algal biomass was far less than that found for macrophytes and the ratio was usually less than 0.05 during August and September. Benthic algae were generally more abundant at the far downstream sites during the spring and late fall seasons. Where macrophytes are abundant, they appear to hold a competitive advantage over benthic algae during July and August.

3.9.3 Macrophyte and Algal Standing Crops

During 1980, preliminary investigations were conducted to discern the distribution and quantity of submerged macrophytes occurring in the Bow River between Calgary and Carseland. In 1980, macrophyte biomass exceeded 1000 $gm \cdot m^{-2}$ (dry wt.) at Site M3R immediately downstream of Bonnybrook, and Site M6R immediately downstream of

TABLE 13 The ratios of benthic algal to macrophyte biomass for the Bow River (1981/82)

SAMPLING SITE																					
M1	M2		M3		M4		M5		M6		M7		M8		M9		M11		M12		SAMPLING DATES
Mid	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	
0	0	1.9	0	1.56	.43	7.73	5.58	.45	1.55	.27	1.37	.51	0	.39	1.46	.84	0	0	0	0	81.04.30 to 81.05.15
0	0	.39	.29	.06	.50	.35	.91	1.23	4.18	1.57	0.33	.63		-	-	-	0	0		0	81.05.16 to 81.05.22
0			-	-	-	-	-	-	4.63	1.42	.39	.20	0	1.39	3.16	0	-	0	-	-	81.05.23 to 81.06.24
0	0	24.34	0	1.7	2.5	3.5	3.18	1.20	-	-	-	-	-	-	-	-	-	-	-	-	81.06.25 to 81.07.02
0	0	0	.07	.16	1.32	8.33	.19	28.0	3.58	8.0	.47	.38	0	0	-	-	-	-	-	-	81.07.03 to 81.07.16
0	-		-	-	-	-	-	-	4.46	.99	.24	.28	0	0	0	0	0	0	0	0	81.07.17 to 81.07.22
0	0	.14	0	0	.05	.14	.10	.09	.23	.10	.04	.04	-	-	-	-	-	-	-	-	81.07.23 to 81.08.14
0	0	.51	0	.10	.08	.37	.25	.12	.08	.04	-	-	0	.21	.25	.16	.16	0	.14	0	81.08.15 to 81.08.25
.53			-	-	-	-	.04	-	-	-	.03	.02	.04	.13	.20	.36	.73	.02	1.25	.07	81.08.26 to 81.08.28
0	0	.14	0	.05	.02	.03	.01	.072	.03	.01	.02	.04	.02	.07	.09	.30	-	-	-	-	81.08.29 to 81.09.18
.154	0	.03	0	.01	.012	.02	-	.023	.02	.02	-	-	-	-	-	-	.06	.06	.04	.06	81.09.19 to 81.09.24
0			-	-	-	-	.02	-	-	-	.02	.04	-	0	.09	0	.05	.10	.03	.06	81.09.25 to 81.09.30
0		-	0	.01	.06	.03	.07	.12	.05	.01	.04	.01	.33	0	.17	0	.20	.25	.29	.27	81.10.01 to 81.10.16
0	-	-	0	.05	.06	.13		0.5	.06	0	.22	.06	-	-	-	-	-	-	-	-	81.10.17 to 81.11.17
					.06	.03			.05												82.07.20 to 82.08.01
					.01	.02			.03												82.08.01 to 82.08.31
					.03	.02			.03												82.09.01 to 82.09.30

Ratios: A:M = Algal $g \bullet m^{-2}$ dry wt:Macrophyte $g \bullet m^{-2}$ dry wt
Mid = Midstream
L = Left side
R = Right side

Fish Creek sewage treatment plant effluents. Conversely, the left bank Sites at M3L and M6L supported a significantly lower biomass (164 - 800 $g \bullet m^{-2}$ dry wt).

Little or no growth occurred during the summer of 1981 at Site M1, M2L, M3L, M10 and M13 (Figure 20). At the remaining sampling points, a distinct seasonal pattern was apparent. During May, plant growth was apparent at most locations, but average densities were less than 10 $g \bullet m^{-2}$ dry wt. By mid-July macrophyte growth was again apparent at M3L, M3R, M5L, M7R and M11L, where densities at all sites were less than 150 $g \bullet m^{-2}$ dry wt. For most sites, particularly those downstream of M7, greatest macrophyte biomass accumulation occurred after mid-August. Macrophyte populations peaked at most sites during mid to late September, after which time densities rapidly declined.

Macrophytes contributed the greater proportion of primary producer instantaneous biomass because of their perennial nature; benthic algae on the other hand grow rapidly, senesce, detach and are swept downstream in a period of time ranging from a few days to two or three weeks. Primary producer growth rates were estimated by subtraction using the following formula.

$$\text{Growth Rate} = \frac{\text{Biomass } T_2 - \text{Biomass } T_1}{N}$$

where T = Time
N = Number of days between sampling dates.

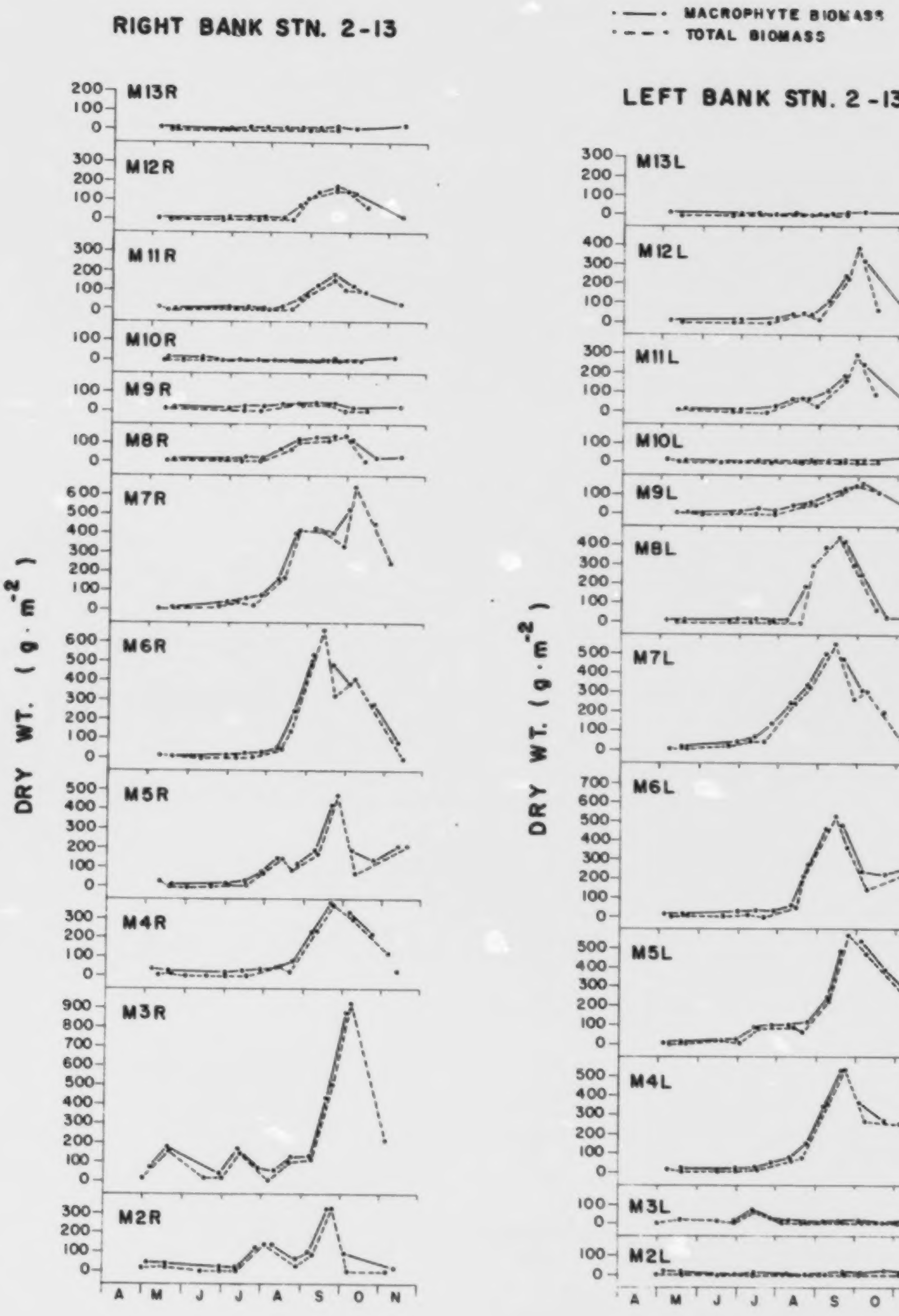

Figure 20. The seasonal variation of macrophyte and macrophyte + algal (total) biomass for 1981 in the Bow River.

Multiple, stepwise regression analysis was performed on the 1981 data in order to define the relative importance of physical factors (depth, velocity, temperature, non-filterable residue) in relation to macrophyte growth rate. All data were log transformed with zero and negative growth rates deleted from the data base. The first six independent variables accounted for only 28% of the macrophyte growth rate variance. Depth was the primary variable, followed by dissolved phosphorus, velocity, nitrate, non-filterable residue and temperature.

Because of the apparent significance of variables other than phosphorus, the 1982 and 1983 field studies were modified to clearly define the role of physical variables on macrophyte growth and development. Biomass accumulation in relation to light (P.A.R. insolation), velocity and depth were monitored at Sites M3R, (Figure 21), M4R (Figure 22) and M6L (Figure 23).

During 1982 macrophyte growth started during July at Sites M3R and M6L and during August at Site M4R. Biomass accumulated to a peak during mid-September at all sites. Macrophyte biomass was highest at Site M3R, and there it frequently exceeding 1000 $g \bullet m^{-2}$ (dry wt) during September 1982 (Figure 21). At Site M6L macrophyte biomass reached 1500 $g \bullet m^{-2}$ (dry wt) also during September 1982. Biomass accumulation was higher as sites having a longer period of growth.

During 1983 macrophyte growth started earlier (during June) and peaked earlier (Figures 21, 22 and 23). Again, the biomass was highest at sites M3R and M6L where the time period for biomass accumulation was longer (Figures 21, 23). Figure 24 depicts the relationship between macrophyte growth rate, light, depth and streamflow velocity. Growth rates were highest at velocities between

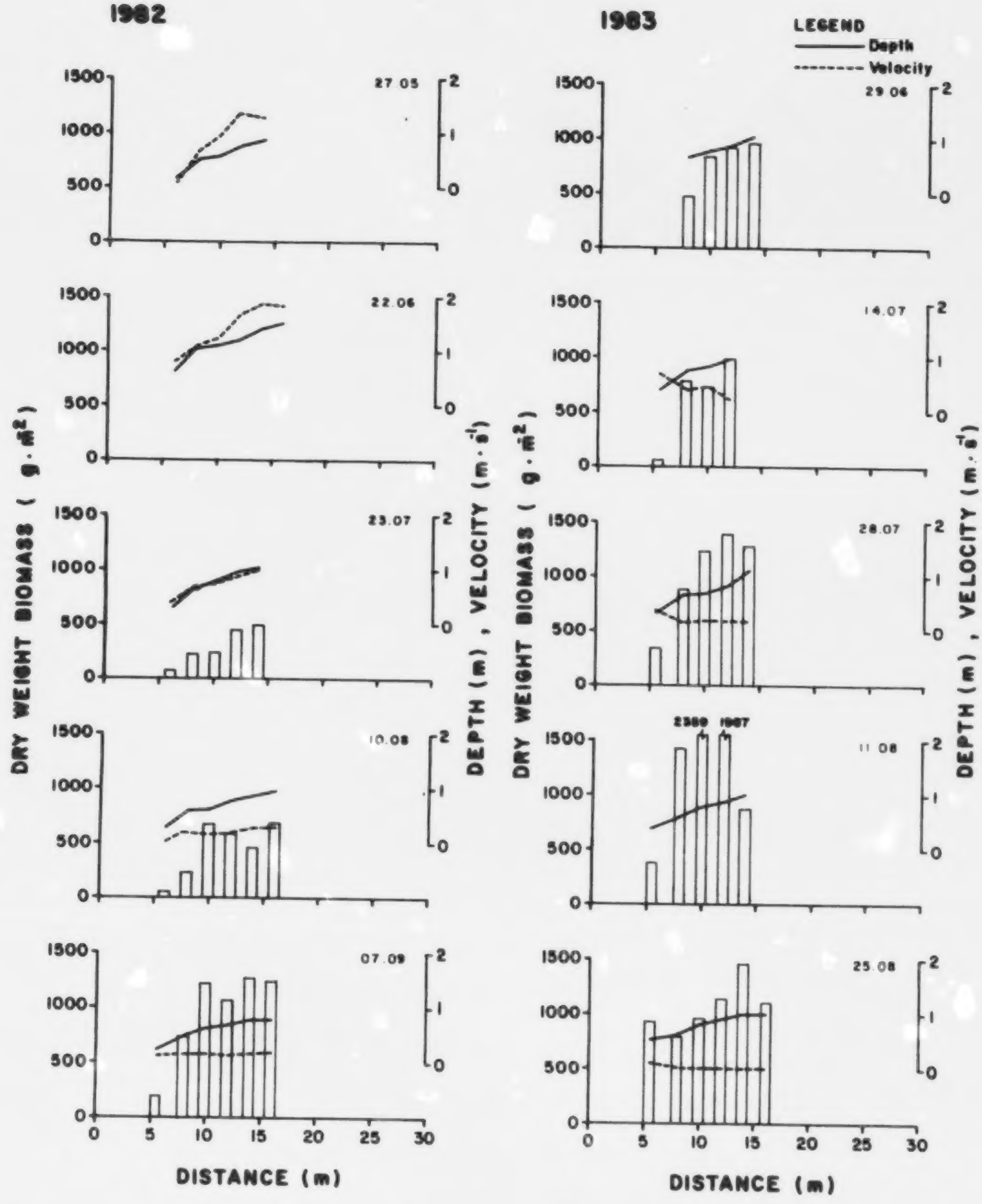

Figure 21. Macrophyte biomass in relation to depth and velocity at Site M3R, downstream of Calgary.

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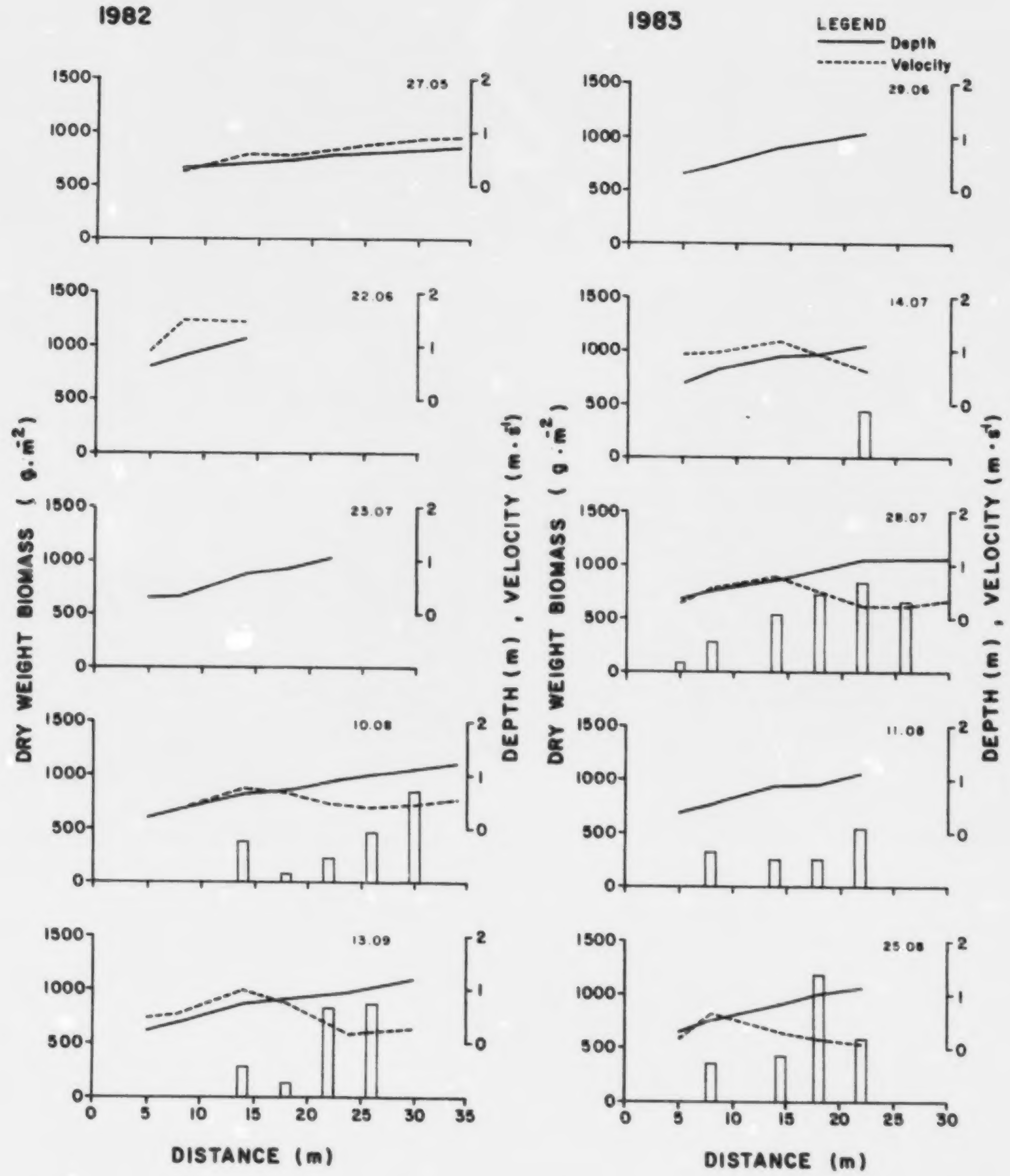

Figure 22. Biomass accumulation in relation to velocity at Site M4R.

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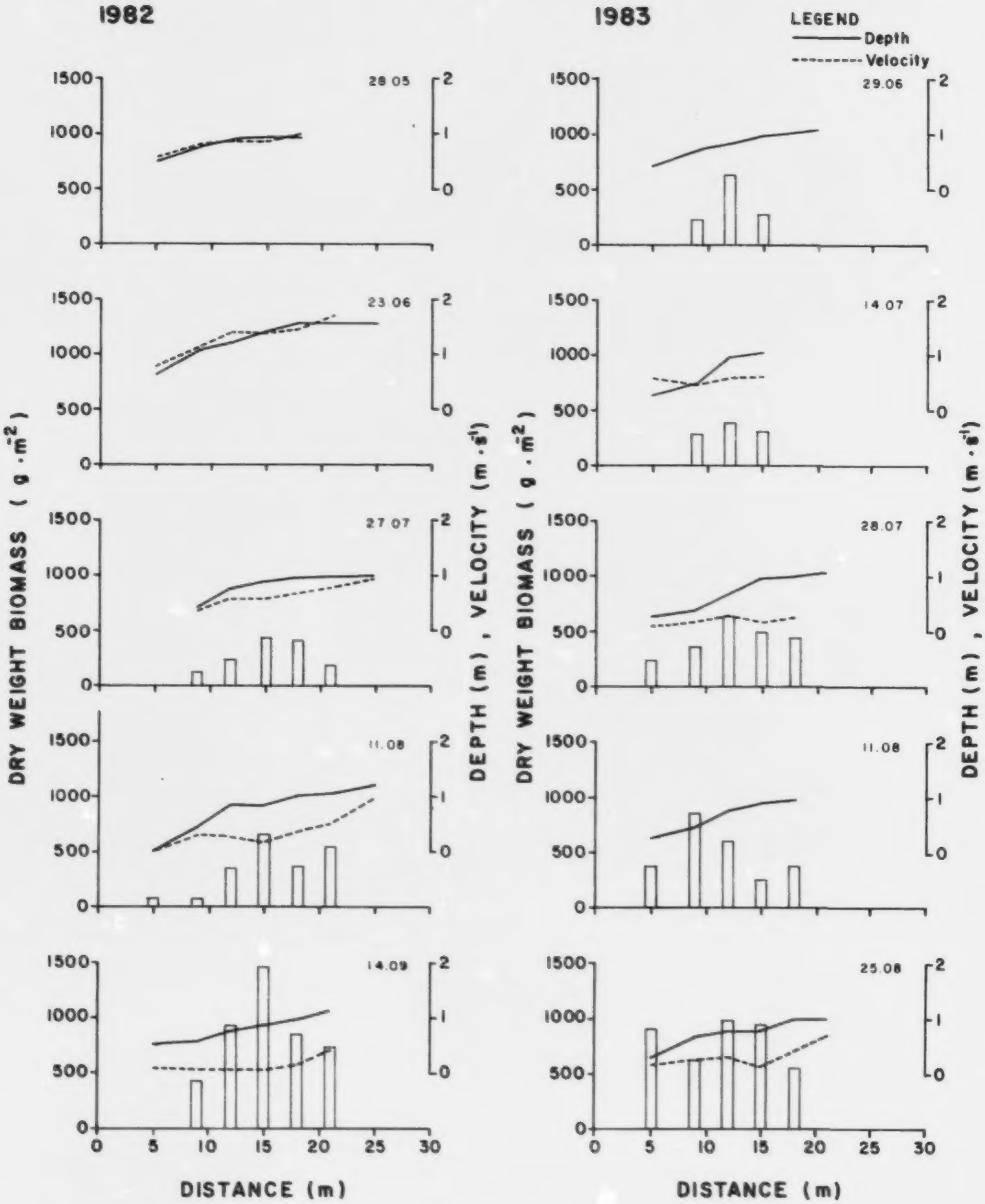

Figure 23. Macrophyte biomass in relation to depth and velocity for M6L downstream of Calgary.

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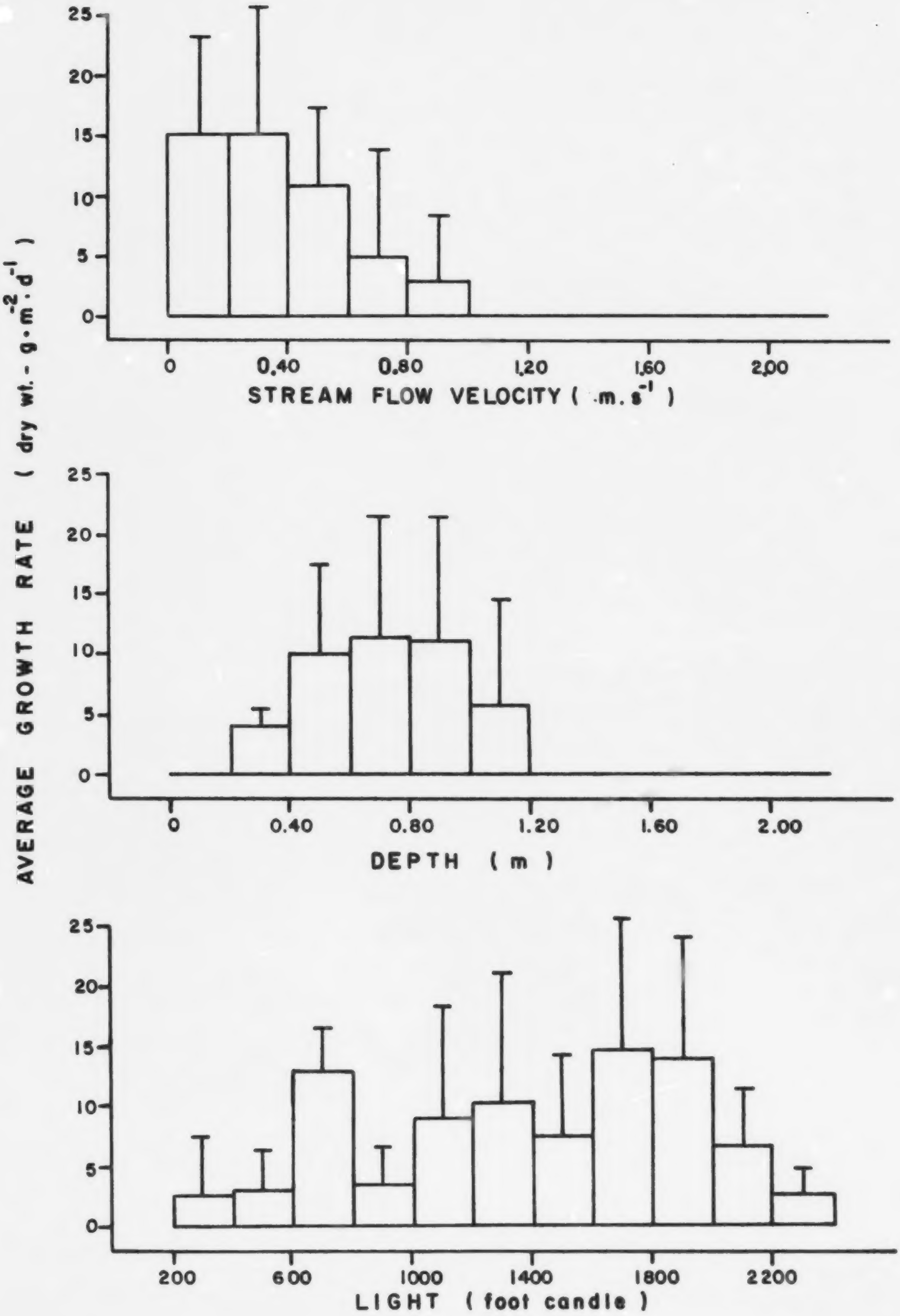

Figure 24. Relationship between physical variables and macrophyte growth rates for Bow River below Calgary.

zero and 0.40 $m \bullet s^{-1}$ with no growth occurring at velocities in excess of 1.00 $m \bullet s^{-1}$. The optimum depth for submerged macrophyte biomass accumulation was 0.40 through 1.00 m. The optimum amount of light for growth of Bow River macrophytes was 600 to 2000 footcandles (Figure 24).

Since physical factors proved to exert a profound influence on macrophyte biomass accumulation, Bow River discharge and velocity were compared for 1978 through 1983. Figures 25 and 26 depict the mean and maximum weekly discharge and mean velocity values for the open water periods.

With the exception of 1979 and 1983, mean weekly discharge during the mountain melt exceeded 250 $m^3 \bullet s^{-1}$ (Figure 25), or an average cross section velocity of 1.8 $m \bullet s^{-1}$ (Figure 26). During 1979 and 1983, average discharge remained at less than 170 $m^3 \bullet s^{-1}$ with an averaged cross section velocity of 1.4 $m \bullet s^{-1}$. Macrophyte biomass was lower during the years in which velocities exceeded 1.8 $m \bullet s^{-1}$ and higher during the years when velocities fell below 1.4 $m \bullet s^{-1}$. These data indicate that river velocities between 1.8 $m \bullet s^{-1}$ and 1.4 $m \bullet s^{-1}$ represent a critical range beyond which macrophyte tissue is scoured. River velocity is a critical factor influencing the abundance and distribution of macrophytes in the Bow River downstream of Calgary.

3.9.4 Temperature and Macrophyte Development

Although the specific effect of Bow River temperature was not examined in detail, it appeared that warming in May may stimulate vegetative growth of submerged macrophytes. During May, river

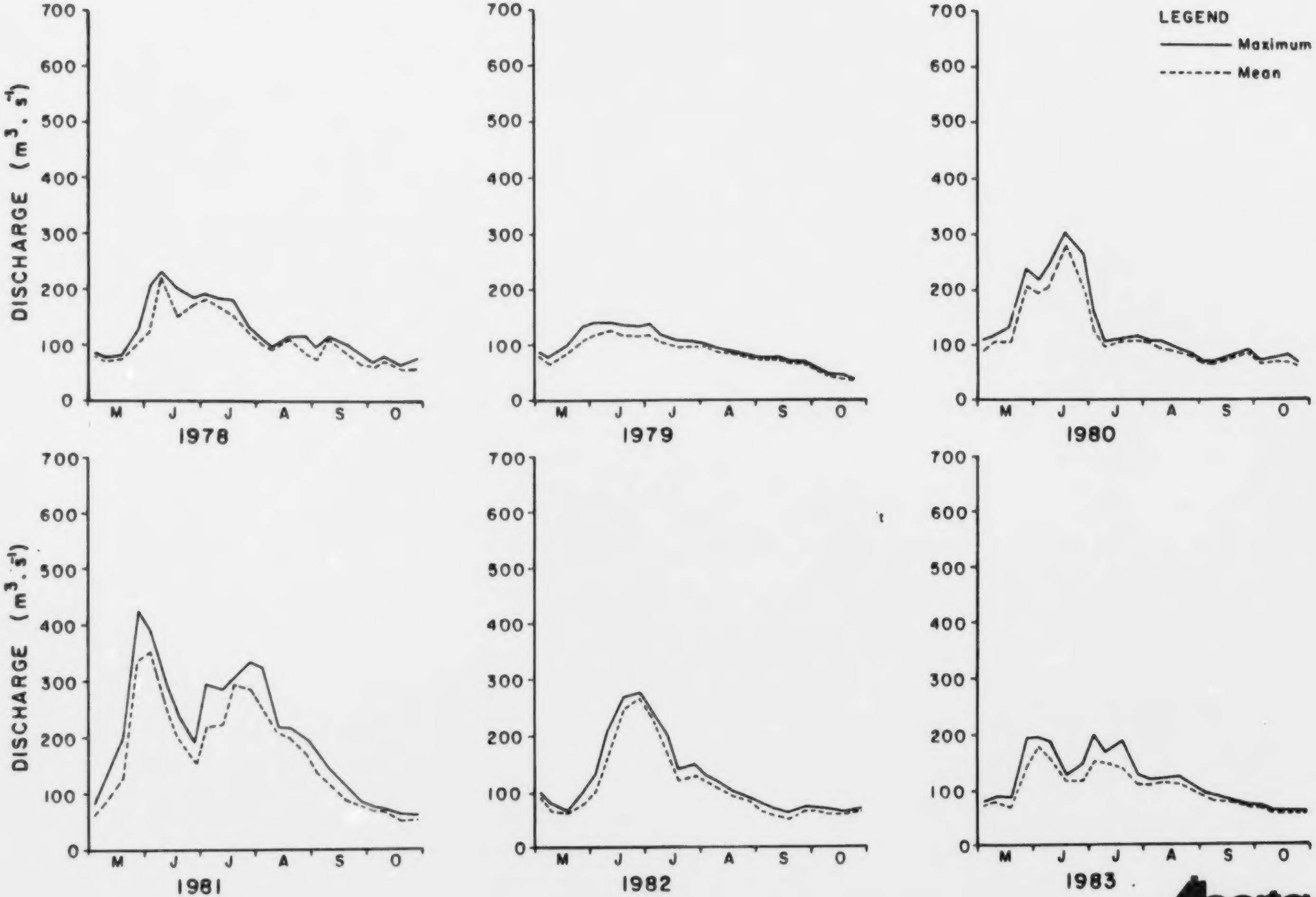

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Figure 25. Mean weekly discharges for the Bow River at Calgary, 1978 - 83.

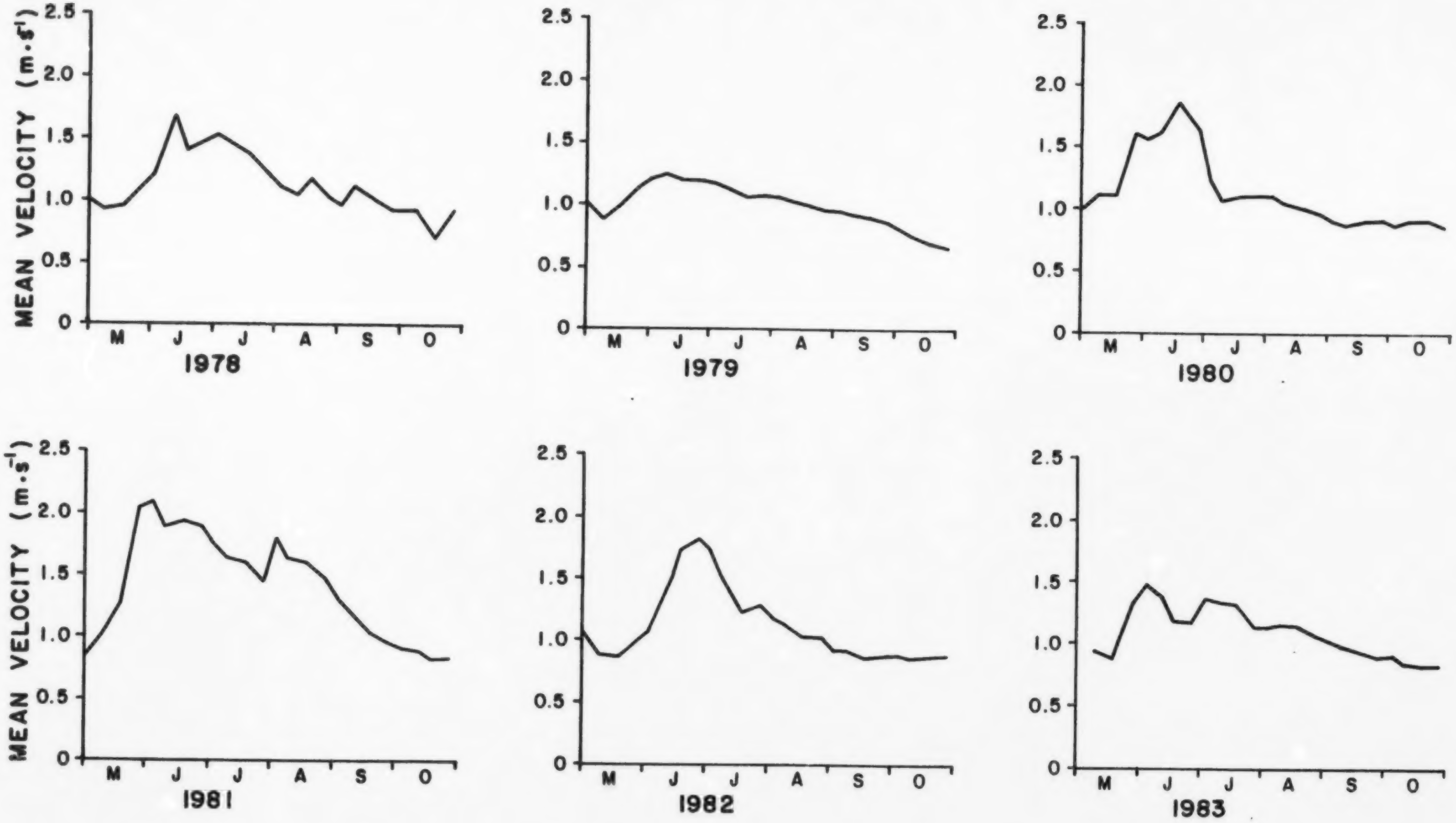

Figure 26. Mean weekly velocities for the Bow River at Calgary, 1978 - 83.

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temperatures generally range from 3 to 10° C with the exception of 1981 when temperatures were 8 to 10° C (Figure 27). Moreover, Bow River temperatures steadily increased and peaked on average at less than 18° C during late July or August. An exception occurred during 1981 when temperatures remained above 15° C until late September. The growth period was probably extended at that time. The average for September ranged from 11 to 13° C.

3.9.5 Bow River Course Trends (Chemical and Biotic)

3.9.5.1 Chemical (Dissolved Phosphorus)

During 1981 dissolved phosphorus (DP) concentrations were monitored for both left and right bank stations in conjunction with the biotic studies. Figure 28 depicts the average concentrations detected. Dissolved phosphorus was consistently low at Site M1 upstream of the Bonnybrook sewage treatment plant. At Site M2R dissolved phosphorus concentrations were raised by inputs from sewage treatment plant effluent. However, dissolved phosphorus values decreased between Sites M2R and M5R because of dilution and uptake. Inputs of Fish Creek sewage treatment plant effluent again raised the concentration of dissolved phosphorus at Site M6R. The concentration of dissolved phosphorus continually increased in a downstream direction at left bank stations as sewage treatment plant effluent was diffused into the entire river. Complete mixing had occurred between Sites M8 and M9 (Figure 28). Low dissolved phosphorus values at Site M10R reflected the dilution effect caused by the Highwood River water. The same general dissolved phosphorus river course pattern was exhibited during 1982, when overall average concentrations tended to be higher as a result of reduced river discharge (Cross *et al*. 1986).

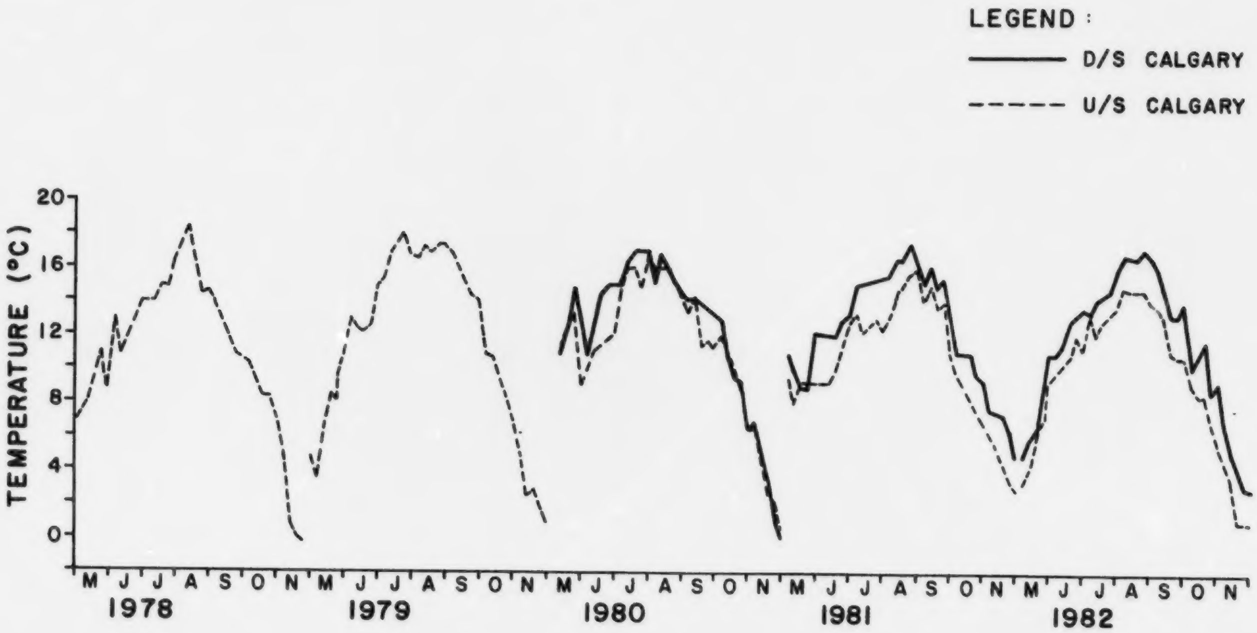

Figure 27. Mean weekly river temperatures in the Bow River upstream and downstream of Calgary.

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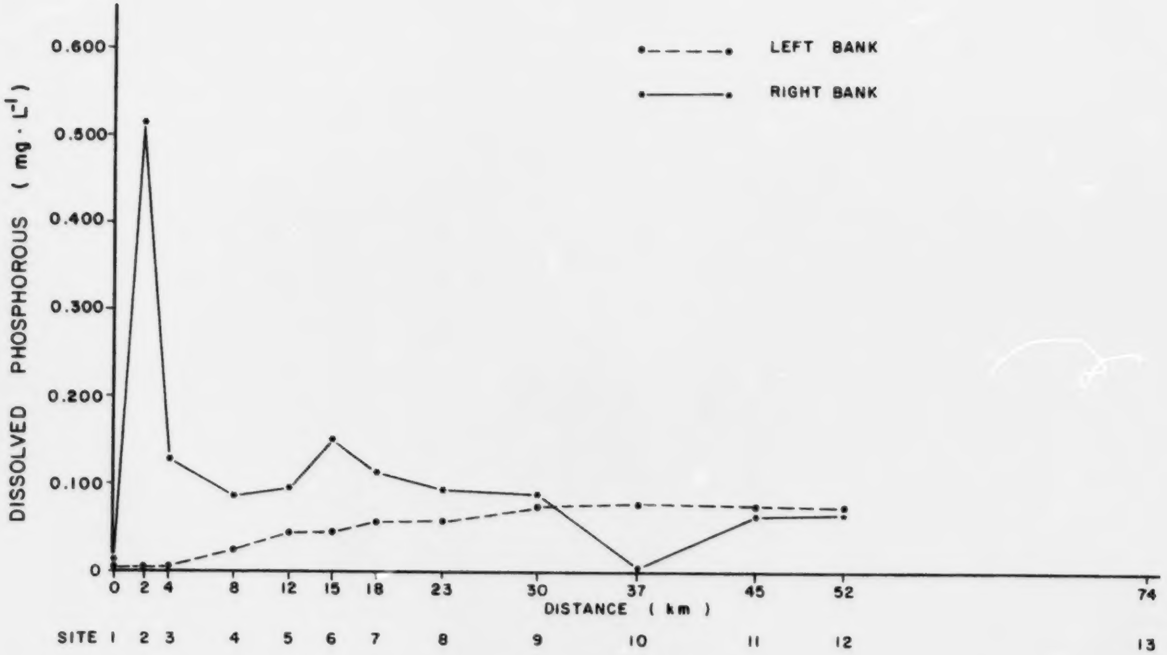

Figure 28. Ambient dissolved phosphorus concentrations for left and right bank stations in the Bow River downstream of Calgary (1981).

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3.9.5.2 Biotic (Peak Macrophyte Standing Crop)

As there was an observed phosphorus gradient between left and right bank locations and with downstream distance, the abundance of aquatic macrophytes was evaluated for similar trends. It was hypothesized that if a cause and effect relationship did exist between phosphorus and weed growth, then the average ambient phosphorus concentration at a particular river location should be correlated with peak macrophyte abundance. The peak, or terminal, biomass achieved in late August or early September was selected as the pertinent biomass parameter for two reasons. First, since macrophyte biomass accumulated over the entire growing season, (unlike benthic algae which has a rapid turnover rate), maximum biomass achieved is an integrator of growth conditions throughout the entire summer. Second, by specifically sampling the most prolific growth zones at each site the possible over-riding influence of physical control of growth was eliminated. In this section of the river spatial and temporal patterns in peak macrophyte biomass were tested statistically first. These patterns were then related to corresponding phosphorus concentrations.

A comparison of plant densities at the right and left bank sampling sites using paired Student's t-tests (Table 14), generally indicated bank to bank differences for sites closest to Calgary and, therefore, in the mixing zone of the effluent from the two Calgary sewage treatment plants. The Bonnybrook plant discharged upstream of Site M2 and the Fish Creek plant discharged between Sites

TABLE 14 Results of paired T-Tests comparing peak macrophyte biomass between right and left banks.

SITE	1981	1982	1983
M2	+	+	+
M3	+	+	+
M4	+	+	
M5	+	+	+
M6		+	+
M7		+	
M8	+		
M9	+		
M10			
M11			
M12		+	

M5 and M6. Downstream of Site M7, the macrophyte biomass tended to be similar along both sides of the river. Chemical data indicated complete mixing of the water system downstream of Site M9.

Analysis of variance followed by the Student-Newman-Keuls _a posteriori_ test for significant difference between sample means was utilized to test for river course trends in peak biomass (Figure 29). The vertical lines indicate groups with common means. Only non-overlapping groups are significantly different (P = 0.05). A maximum downstream gradient in biomass was apparent along both banks in 1981. In the subsequent two years less variation existed between sampling locations.

For right bank sites in 1981, maximum densities occurred downstream of Bonnybrook and Fish Creek sewage treatment plants, while a progressive decrease was evident with distance below the city. The one anomaly to this pattern was the first right bank site immediately below the Bonnybrook sewage treatment plant effluent release. At this site, dry weights were lower than at the next downstream site, and at the sites downstream of the Fish Creek sewage treatment plant. In 1982 the gradient in right bank densities observed in 1981 was largely eliminated. Compared to other sites, plant densities in 1983 were significantly greater for right bank sites downstream of the two sewage treatment plant discharges.

Sites M2L and M3L experienced little or no macrophyte growth in any of the three years. During 1981 plant growth at the furthest downstream locations was reduced relative to sites closer to Calgary. This pattern was not apparent in the subsequent years when, with the exception of M2L and M3L, left bank densities were similar.

FIGURE 29 Analysis of Macrophyte Biomass Variance at Right Bank and Left Bank Stations downstream of Calgary (Student-Newman-Keuls procedure). Peak mean biomass in $g \cdot m^{-2}$

RIGHT BANK

1981

BIOMASS	SITE	GROUP			
0	M10	|			
0.06	M9	|			
0.13	M11	|	|		
0.18	M8	|	|		
0.25	M12	|	|		
0.43	M2		|		
0.45	M5		|		
0.47	M4		|		
0.80	M6			|	
0.97	M7			|	
1.23	M3				|

1982

BIOMASS	SITE	GROUP			
0.30	M12	|			
0.61	M11	|	|		
0.75	M10	|	|	|	
0.83	M5	|	|	|	
0.88	M8	|	|	|	
1.13	M9	|	|	|	
1.22	M4	|	|	|	|
1.27	M7	|	|	|	|
1.42	M3		|	|	|
1.62	M2			|	|
1.87	M6				|

1983

BIOMASS	SITE	GROUP			
0.63	M12	|			
0.81	M10	|			
0.85	M11	|			
0.88	M5	|			
1.07	M9	|			
1.17	M8	|			
1.47	M4	|	|		
1.62	M3	|	|		
2.16	M7		|	|	
2.52	M6			|	|
3.18	M2				|

LEFT BANK

1981

BIOMASS	SITE	GROUP	
0	M2	|	
0	M10	|	
0.07	M3	|	
0.17	M9	|	
0.19	M11	|	
0.21	M12	|	
0.73	M4		|
0.76	M8		|
0.76	M7		|
0.78	M5		|
0.79	M6		|

1982

BIOMASS	SITE	GROUP		
0	M2	|		
0	M3	|		
0.57	M10		|	
0.62	M12		|	
0.67	M4		|	
0.67	M11		|	
0.68	M9		|	
0.72	M7		|	
0.96	M8		|	|
1.02	M6		|	|
1.22	M5			|

1983

BIOMASS	SITE	GROUP		
0	M2	|		
0	M3	|		
0.63	M9		|	
0.66	M12		|	
0.73	M6		|	
0.75	M10		|	
0.87	M5		|	
0.93	M4		|	
1.02	M11		|	
1.08	M7		|	
1.61	M8			|

Between year comparisons for each site (Table 15) indicate for right bank locations 1981 standing crops tended to be significantly less than corresponding densities for 1982 and 1983. Only at M2R, M7R and M12R was there a significant difference between 1982 and 1983. At left bank sites upstream of M7 and at Site M12R, there was no significant variation between any of the three years. The 1981 biomass was significantly less than that for the other two years for most downstream sites. Variation between 1982 and 1983 occurred only at Sites M7L and M8L.

Spatial patterns in plant density existed within the mixing zone, and there is also year to year variation. How these patterns related to average phosphorus concentrations in the surrounding water is presented in Figure 30. At sites that had extremely low average dissolved phosphorus concentrations, less than 0.005 mg•L^{-1}, macrophyte biomass was considered essentially to be zero.

High macrophyte densities can occur at ambient dissolved phosphorus concentrations greater than 0.010 mg•L^{-1}. Maximum plant densities in 1982 and 1983 were similar. However, ambient phosphorus concentrations were significantly less in 1983, following implementation of phosphorus removal at the two Calgary sewage treatment plants. The greatest variation in plant biomass between sites occurred in 1981, when there were low standing crops even at dissolved phosphorus concentrations ranging between 0.060 and 0.090 mg•L^{-1}.

TABLE 15 Results of paired T-Tests comparing peak macrophyte biomass between years.

	LEFT BANK			RIGHT BANK		
SITE	1981/82	1981/83	1982/83	1981/82	1981/83	1982/83
M2				+	+	+
M3						
M4					+	
M5						
M6				+	+	
M7		+	+		+	+
M8		+	+	+	+	
M9	+	+		+	+	
M10	+	+		+	+	
M11	+	+			+	
M12					+	+

+ - Statistically Significant

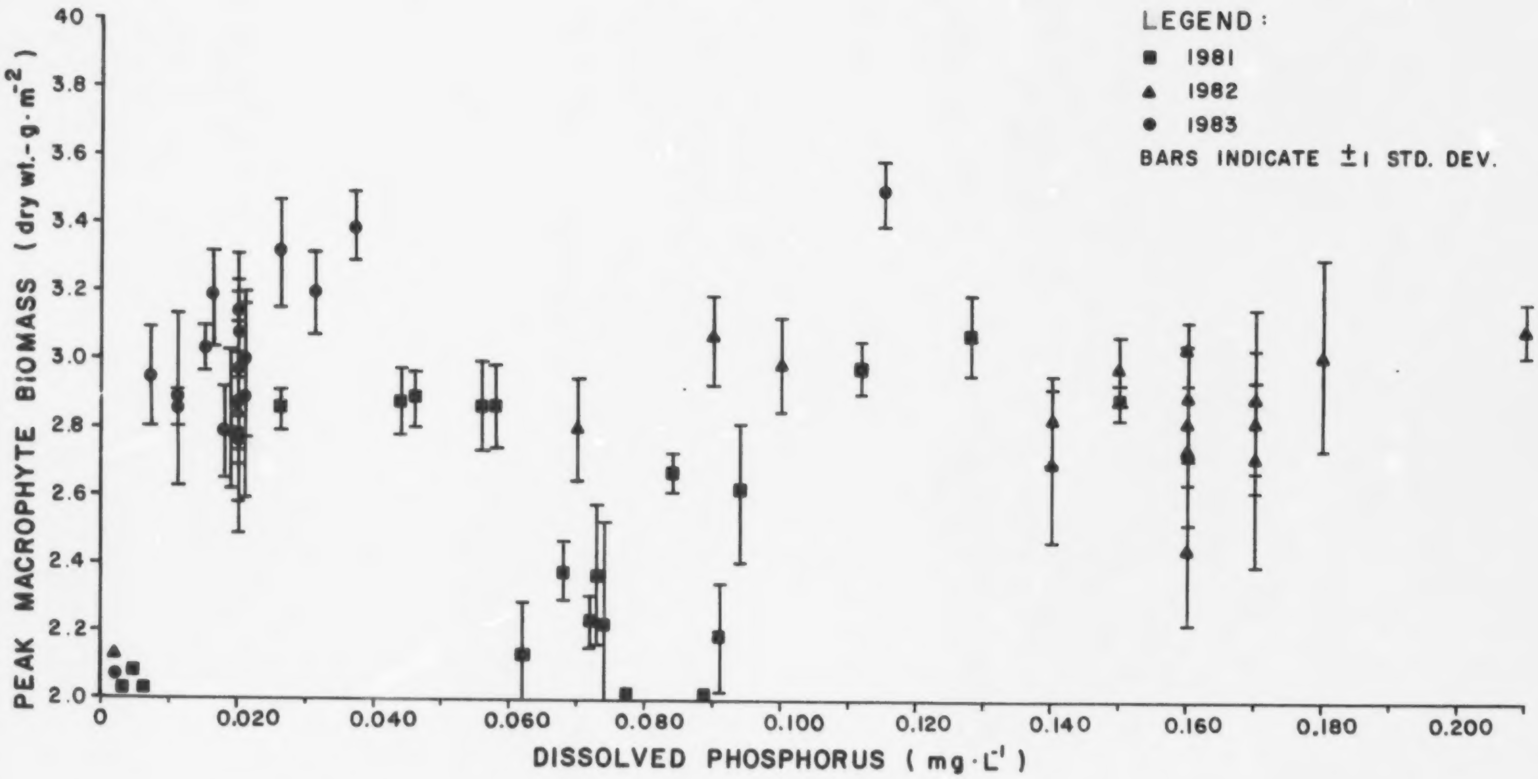

Figure 30. Macrophyte biomass (peak) in relation to ambient DP in the Bow River 1981 - 82.

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4.0 CLUSTER ANALYSIS

A multivariate analysis program entitled Clustan (Wishart 1975) was employed for both cluster and principal components analysis (PCA) of the extensive database acquired for the South Saskatchewan River Basin. Mean seasonal values for each variable were utilized to group (cluster) biological and chemical data. Cluster analysis included data for the seven periods from spring 1980 through fall 1981, inclusive.

Cluster analysis permitted grouping of river sampling station data based upon similarities among sites. Principal component analysis was then utilized to distinguish the variables which were most important for defining each cluster. This procedure included the calculation of a correlation matrix from which eigenvalues and eigenvectors were derived. The proportion of the total variance in the data can be explained by each eigenvector which was derived from the eigenvalue.

The following parameters were utilized: dissolved phosphorus, dissolved nitrogen, non-filterable residue, particulate organic carbon, pH, silica, epilithic chlorophyll a, ^{14}C uptake rate, number of Cyanophyta, Chlorophyta, Bacillariophyta, net radiation, temperature and discharge. Table 16 presents the site and seasonal components of each cluster in addition to the mean values for each variable contained in the clustered data. Figure 31 presents the distribution of the clusters in relation to the geographic location of each site. Sites located downstream of Site 5 on the Bow River, and the entire Oldman and South Saskatchewan River, were similar biologically and chemically within each season during fall, summer and

TABLE 16 Site, season and mean values associated with each cluster component for the South Saskatchewan River Basin 1980/81.

	CHEMICAL, BIOLOGICAL AND PHYSICAL VARIABLES						
GROUP CLUSTER	CHL a	PRO	DP	DN	NFR	POC	pH
1 (n = 12)	38	56	.038	.43	448	3.0	5.7
2 (n = 18)	96	144	.024	.29	17	.51	2.3
3 (n = 25)	44	31	.067	.66	26	.86	6.6
4 (n = 18)	71	48	.050	.67	21	.90	3.8
5 (n = 9)	283	99	.176	1.3	16	.85	11
GROUP CLUSTER	SI	DISC	LITE	TEMP	CYANO	CHLOR	BACI
1 (n = 12)	2.9	278	5.2	9.2	7.8	2.6	5.7
2 (n = 18)	1.5	115	5.4	19	15	6.5	7.1
3 (n = 25)	3.0	109	3.0	6.0	4.9	1.3	11
4 (n = 18)	.73	58	1.7	7.8	10	3.1	21
5 (n = 9)	3.1	91	3.7	7.4	7.7	11	41

CLUSTER GROUPING

CLUSTER	SITE	SEASON	CLUSTER	SITE	SEASON	CLUSTER	SITE	SEASON
1	3	P80, P81, W81	2	3	S80, S81	3	3	F80, F81
	4	P80, P81		4	S80, S81		4	W81
	8	P80, P81		8	S80, S81		8	W81
	9	P80		9	S80, S81		9	P81, W81
	10	P80, P81		10	S80		10	W81
	11	P81		11	S80, S81		11	W81
	12	P81		12	S81		12	W81
				5	S80		1	P81, S80, S81 F80, F81, W81
				6	S80		5	P81, S81
				13	S80, S81		6	P80, W81
				7	S80, S81		13	P80, P81, W81
							7	P80, P81, W81

CLUSTER	SITE	SEASON	CLUSTER	SITE	SEASON
4	4	F80, F81	5	2	P80, P81, S80, F80, W81
	8	F80, F81		5	P80, F80, F81, W81
	9	F80, F81			
	10	F80, F81			
	11	F80, F81			
	12	F80, F81			
	6	F80, F81			
	13	F80, F81			
	7	F80, F81			

P - Spring
S - Summer
F - Fall
W - Winter

Units are in mg•L^{-1} except: CHL a (mg•m^{-2}), PRO (mg•m^{-2}•h^{-1}), pH (pH units), DISC (m^{3}•s^{-1}) LITE (MJ•m^{-2}), TEMP (°C), CYANO, CHLOR, BACI (cells x 10^{9}•m^{-2})

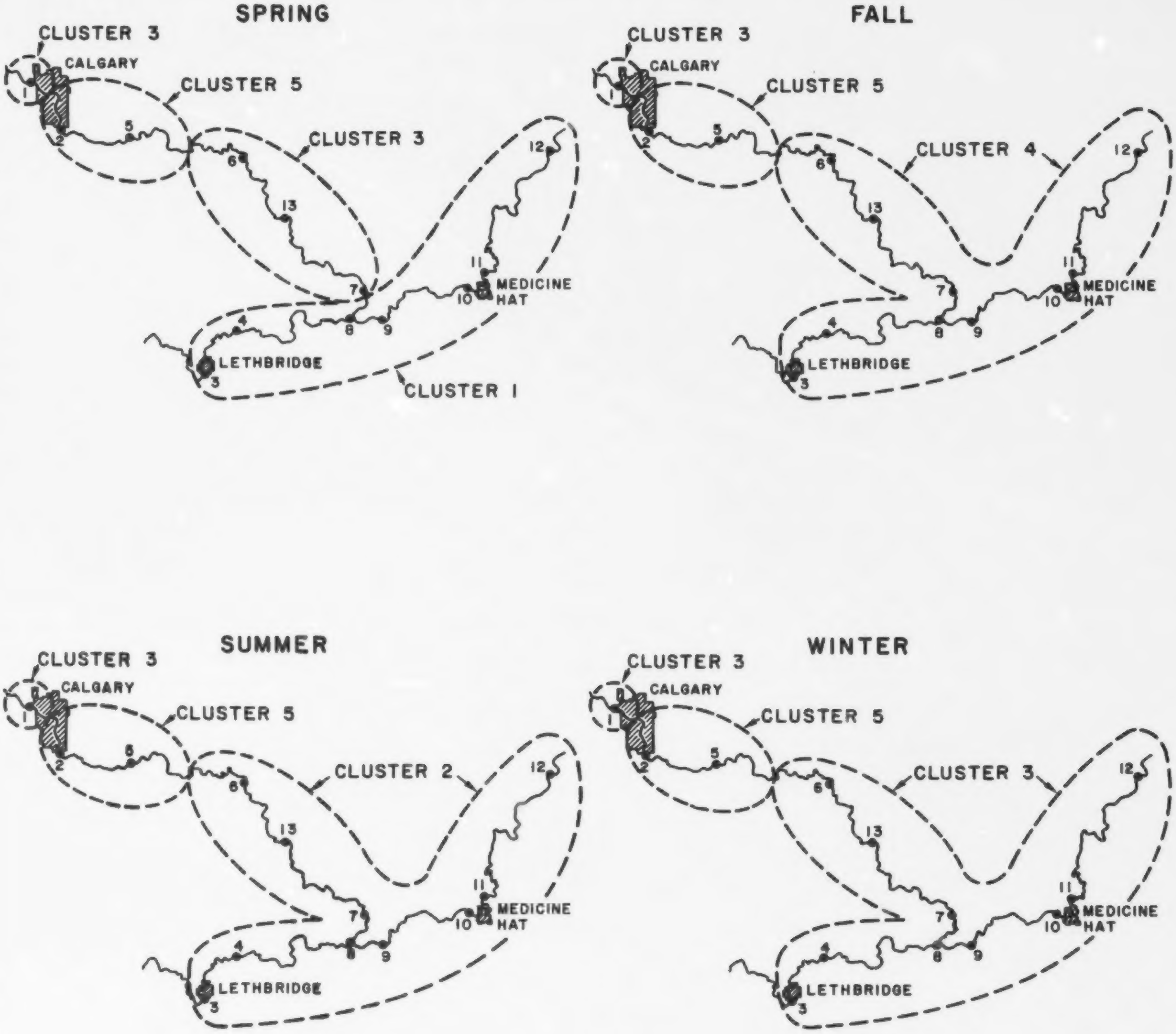

SPRING
CLUSTER 3
CALGARY
CLUSTER 5
CLUSTER 3
CLUSTER 1
1
2
3
4
5
6
7
8
9
10
11
12
13
MEDICINE HAT
LETHBRIDGE
FALL
CLUSTER 3
CALGARY
CLUSTER 5
CLUSTER 4
MEDICINE HAT
LETHBRIDGE
SUMMER
CLUSTER 3
CALGARY
CLUSTER 5
CLUSTER 2
MEDICINE HAT
LETHBRIDGE
WINTER
CLUSTER 3
CALGARY
CLUSTER 5
CLUSTER 3
MEDICINE HAT
LETHBRIDGE

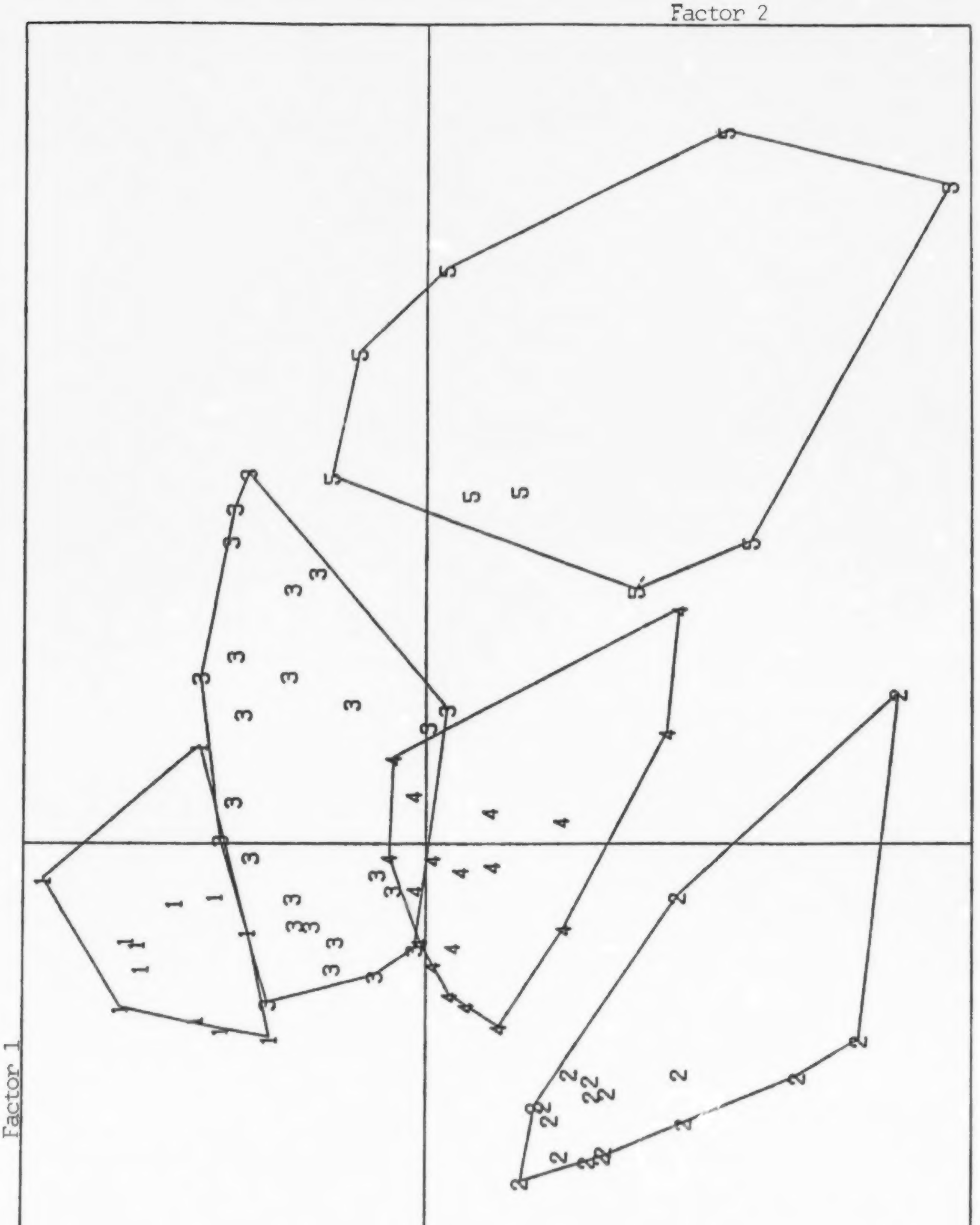
Figure 31 The distribution of clusters in relation to their geographic location and seasonal similarity for the South Saskatchewan River Basin .

winter. During the spring season, sites 6, 7 and 13 on the lower Bow River clustered separately from sites on the Oldman and South Saskatchewan rivers. Sites 2 and 5 immediately downstream of Calgary, and Site 1 upstream of Calgary (separately), consistently clustered for all seasons.

Figures 32 and 33 depict the specific distribution of clusters. Clusters 2, 4 and 5 were divided along the first vector. Twenty-eight percent of the variation that occurred in the first vector was accounted for by dissolved nutrients, specifically dissolved nitrogen and dissolved phosphorus. Clusters 1, 3 and 4 contained seasonal data that had intermediate nutrient concentrations but were divided along vector two. Non-filterable residue, particulate organic carbon and discharge accounted for twenty percent of the variation along this vector.

Cluster 1 (Figures 32, 33) contained spring data from sites on the Oldman and South Saskatchewan rivers. These sites had the highest values for non-filterable residue, particulate organic carbon and discharge and lowest values for benthic standing crop and numbers of Bacillariophyta. Scour and discharge related variables appeared to reduce algal standing crop, particularly diatoms, in the Oldman and South Saskatchewan rivers.

Cluster 2 contained summer data from all South Saskatchewan River Basin sites except those upstream of Calgary (Site 1) and immediately downstream of Calgary (Sites 2 and 5). Cluster 2 represented the lowest values for dissolved phosphorus, dissolved nitrogen, particulate organic carbon, H^+ ions (high pH) and the highest values for ^{14}C uptake (benthic productivity), temperature and numbers of Cyanophyta. Productive, predominantly blue-green algae, appeared to



PLOT NUMBER 2.

SSRBECS CLUSTER AND PRINCIPAL COMPONENTS ANALYSIS - COMBINED PARAMETERS.

Figure 32. Graphic distribution of South Saskatchewan River seasonal data clusters.

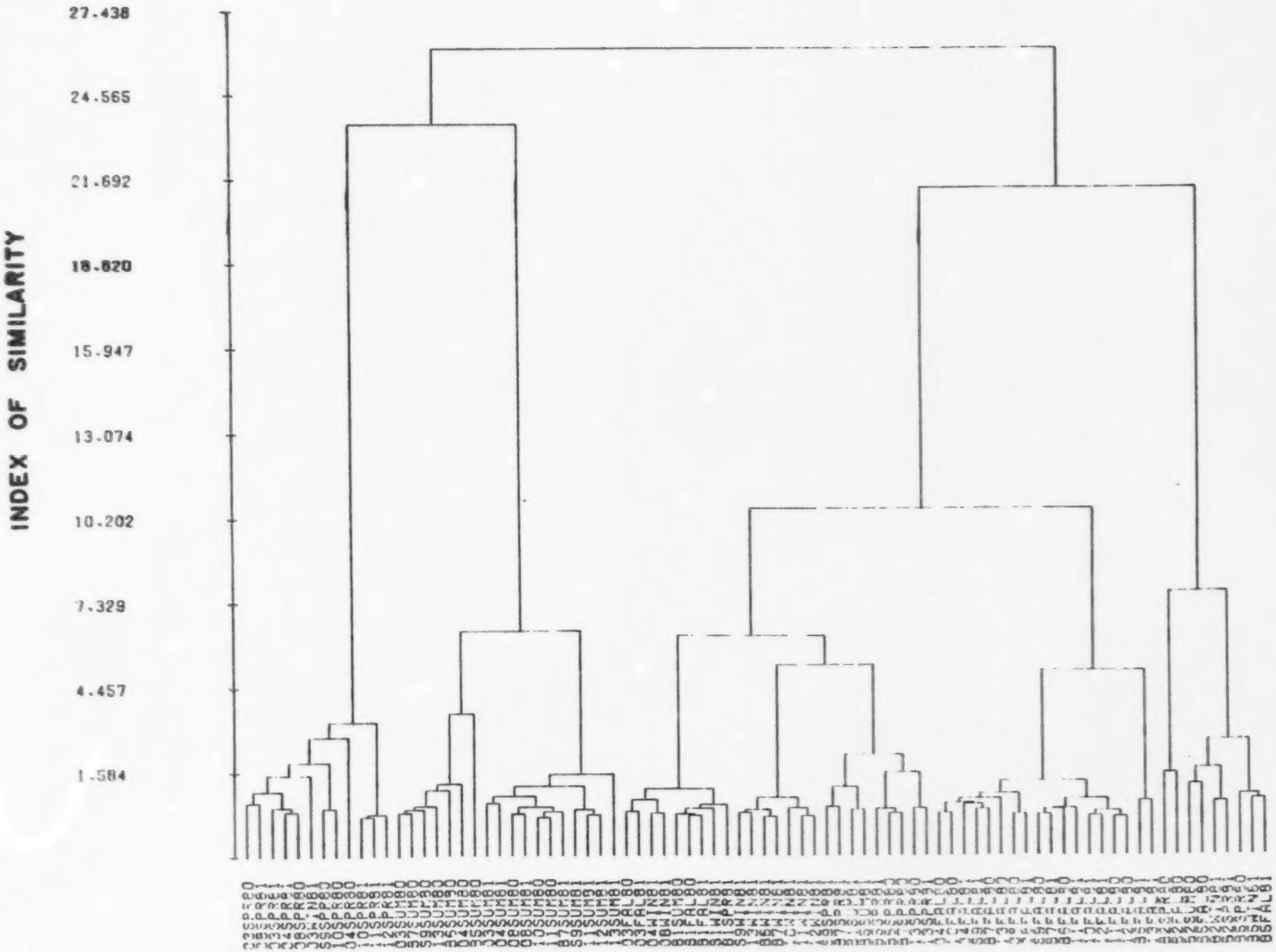


Figure 33. Dendrogramatic illustration of the South Saskatchewan River clusters and their principal components.

flourish in these reaches, even when dissolved phosphorus and dissolved nitrogen concentrations were low, during the warm water period.

Cluster 3 contained data for Site 1 in all seasons, most sites in winter and Sites 6, 13 and 7 in spring. This cluster was characterized by the lowest benthic productivity, temperature, numbers of Cyanophyta and Chlorophyta. The cold water period was particularly unproductive in the South Saskatchewan River basin at the time when Cyanophycean and Chlorophycean algae were least abundant numerically.

Cluster 4 contained mostly fall values and had the lowest concentration of silica, discharge and insolation. The dominant algae were diatoms and silica is a major component of diatom cell walls. Uptake of silica by diatoms reduced silica concentrations in the river water during the fall season.

Cluster 5 contained data from Sites 2 and 5 immediately downstream of Calgary. This cluster was characterized by the lowest non-filterable residue values and highest benthic standing crop, dissolved phosphorus, dissolved nitrogen, H^+ ions (low pH), silica, numbers of Chlorophyta and Bacillariophyta. This cluster represented the enriched zone of the Bow River where maximum macrophyte and benthic standing crops developed because of lack of scour and an abundance of nutrients. Benthic algal accumulations over the river substrate may have been self-limiting, and actually less productive than river areas where senescent algae were rapidly scoured away.

Following the cluster analysis, the periodic data and the original data (not seasonal means) were grouped according to their clusters and analyzed using regression techniques.

When all the periodic data were treated as a group, multiple regression analysis showed that benthic chlorophyll a was most highly correlated with dissolved phosphorus, temperature and discharge respectively. Simple regression analysis also showed the correlation with dissolved phosphorus, dissolved nitrogen and nitrate/nitrite. Productivity was found to have lower correlation coefficients that were particularly influenced by temperature, dissolved phosphorus and discharge.

Table 17 presents the results of the regression analyses including both the periodic and unaveraged data. Five clusters were defined and the relationships between epilithic primary producer chlorophyll a and ^{14}C uptake was compared between physical and chemical variables.

Analysis of Cluster 1 data (spring in Oldman and South Saskatchewan rivers) showed no strong relationships with biomass but productivity was correlated with phosphorus forms using periodic data, and particulate variables using unaveraged data.

Cluster 2 data (summer) showed a strong correlation between biomass and dissolved phosphorus, using multiple regression. Other phosphorus and nitrogen forms were also highly correlated using simple regression. Productivity was correlated with phosphorus forms and inversely correlated with temperature using periodic data. Productivity showed an additional inverse relationship with turbidity and silica using unaveraged data

Multiple regression analysis of fall periodic data (Cluster 4) showed biomass most closely correlated to non-filterable residue, followed by discharge. Total phosphorus and particulate organic

TABLE 17 Results of regression analysis using periodic and unaveraged data for biomass and productivity vs. chemical and physical variables.

DATA SET	MULTIPLE REGRESSION Variables	Coefficient	CORRELATION COEFFICIENT Variables	Coefficient	N
All data					
- Periodic	Chl vs DP	.60	Chl vs DP	.61	88
	Temp	.70	OP	.60	88
	Disc	.72	DN	.56	88
	Pro vs Temp	.38			
	DP	.46			
	Disc	.52			
	OP	.57			
Cluster 1					
- Periodic	Pro vs OP	.81	Pro vs OP	.81	12
	TP	.92	DP	.73	12
			PN	.69	12
			TP	.66	12
- Unaveraged			Pro vs Turb	.75	23
			TP	.75	23
			POC	.63	23
			PN	.62	23
Cluster 2					
- Periodic	Chl vs DP	.86	Chl vs DP	.83	21
			DN	.82	21
			Nit	.79	17
			OP	.78	21
			TP	.73	21
			Temp	-.69	18
	Pro vs DP	.73	Pro vs DP	.67	18
	TP	.83	OP	.56	18
			Temp	-.69	18
- Unaveraged			Chl vs DP	.69	63
			OP	.67	63
			Pro vs Turb	-.57	27
			Si	-.51	27
Cluster 3					
- Periodic	Chl vs Light	.65	Chl vs Light	.65	26
Cluster 4					
- Periodic	Chl vs NFR	.83	Chl vs NFR	.83	18
	Disc	.94	POC	.83	18
			TP	.71	18
	Pro vs Si	.48			
Cluster 5					
- Unaveraged			Pro vs DOC	-.55	24

carbon were also correlated using simple regression. Productivity was weakly correlated to silica.

Cluster 3 showed biomass correlated to light using periodic data and no strong correlations with productivity. Cluster 5 (Bow River Sites 2 and 5) showed no relationships using periodic data, but unaveraged data showed a negative correlation between productivity and dissolved organic carbon.

4.1 Predictive Equations

This investigation has provided evidence of the significant role of nutrients and physical factors in relation to the primary producers. Both biotic and abiotic variables were shown to fluctuate seasonally with some degree of similarity. Therefore, the relationships defined statistically during this study for Clusters 1 and 2 were utilized to formulate equations for predicting future primary producer abundance and productivity.

The highest correlation coefficient (r = 0.81) for predicting benthic algal productivity was obtained using average seasonal data for orthophosphorus from Cluster 1 (spring in the Oldman and South Saskatchewan rivers). A second linear correlation was found for predicting productivity using unaveraged data and total phosphorus. Benthic algal productivity in summer at all sites except 1, 2 and 5 on the Bow River (Cluster 2) can be predicted from summer average seasonal data, however the correlation coefficient was much lower.

The highest correlation coefficient for predicting benthic chlorophyll *a* (r = 0.83) was obtained using average seasonal data for dissolved phosphorus from Cluster 2 (summer at all sites except 1, 2 and 5 on the Bow River). Unaveraged data can also be used with a second equation for this prediction.

It would appear from the above comparisons that benthic algal productivity predictions may best be obtained using the following formula:

1) For spring average seasonal data in the Oldman and South Saskatchewan Rivers;

$$\text{Productivity} = 2.81 \bullet \text{orthophosphorus} - 5.66$$

where productivity is in mg carbon$\bullet m^{-2} \bullet h^{-1}$ and orthophosphorus is in $\mu g \bullet L^{-1}$ (10^{-3} $mg \bullet L^{-1}$)

2) For summer average seasonal data in the lower Bow, Oldman and South Saskatchewan Rivers;

$$\text{Biomass} = 3.05 \bullet \text{dissolved phosphorus} + 21.85$$

where biomass is in mg chlorophyll $\underline{a} \bullet m^{-2}$ and dissolved phosphorus is in $\mu g \bullet L^{-1}$ (10^{-3} $mg \bullet L^{-1}$).

5.0 DISCUSSION

All rivers change along their length with respect to such properties as temperature, depth, current velocity, substratum and chemistry. Moreover, it has been shown that rivers exhibit characteristic zonation with respect to a variety of physical, chemical and biotic variables (Hynes 1976; Guillory 1982; Vanlandingham 1976). Charlton and Hickman (1981) showed that northeastern Alberta rivers originating in muskeg wetlands are frequently more productive in their middle reaches. Although the Bow and Oldman Rivers originate in a mountainous region, they are similarly more productive within their middle reaches.

The merging of these two rivers results in the upper reach of the South Saskatchewan River supporting higher algal standing crops. Unlike northeastern Alberta rivers which are undisturbed, southern Alberta rivers are influenced by industrial, agricultural and domestic inputs, particularly phosphorus. This investigation has provided evidence of the role of phosphorus that resulted specifically in an amplification of primary producer abundance downstream of major nutrient inputs (i.e. downstream of Calgary and downstream of Lethbridge). A description of the temporal characteristics of the algae and macrophytes was also provided.

Lotic algal populations throughout the South Saskatchewan River Basin exhibited temporal patterns similar to those reported for Alberta rivers (Hickman *et al.* 1979; 1982) and other temperate regions of the world (Whitton 1975). With the exception of river regions supporting extensive macrophyte beds, the benthic algae flourished during the open water period. Spring and fall populations were predominantly diatoms which reduce silicate concentrations in the overlying waters. Diatoms occurred throughout the year in greater abundance in the zones of enrichment downstream of urban centres. Schelske *et al*. (1983), hypothesized that nutrient additions increased diatom production and the demand for silica, a major component of their frustules. The phenomenon results in the possible SiO_2 depletion and a shift to primary producers having no silica requirement. Macrophytes have a minimal silica requirement and have been shown to also flourish in the enriched lotic zones that received significant loadings of treated sewage effluent (Wong *et al*. 1976).

Green algae were the least abundant, numerically, of all the algae throughout the South Saskatchewan River Basin and their distribution was very patchy. Algae from this group were more abundant during the summer season. Blue-green algae (Cyanophyta) were the dominant, numerically, of all the algae throughout most of the South Saskatchewan River Basin and during every season. Benthic Cyanophycean algae are predominantly small, closely-adhering forms well adapted to a lotic existence. Macroscopic blue-greens, such as *Nostoc* spp., were particularly abundant in the upper and lower reaches of the Oldman River (Sites 3 and 8) and the upper reach of the Bow River (Site 1). *Nostoc* spp. are well-known nitrogen fixers and their occurrence was indicative of the potential for nitrogen limitation. Moreover, nitrate-nitrite seasonally averaged 0.04 $mg \bullet L^{-1}$ upstream of Calgary, 0.08 $mg \bullet L^{-1}$ upstream of Lethbridge (Site 3), and 0.13 $mg \bullet L^{-1}$ at Site 8 in the lower Oldman River. Findley *et al*. (1973) and Horne and Fogg (1970), noted that although there was no inverse correlation between the rate of nitrogen fixation and the actual concentrations of nitrate and total nitrogen, there was appreciable nitrogen fixation when nitrogen concentrations were less than 0.3 mg•L^{-1}. Nitrogen fixation in the South Saskatchewan River Basin, therefore, was probably of some importance as nitrogen fixed and liberated by blue-green algae resulted in additional nutrients being added and ultimately being made available for the growth of other algae and aquatic plants.

Although the Bow and Oldman rivers both supported higher aquatic plant standing crops downstream of major nutrient inputs, the problem was particularly acute downstream of Calgary where growth occurred at very high levels. Results from this investigation have shown that discharge and related variables (i.e., velocity, non-filterable residue, turbidity, scour) play a major role with respect to biomass accumulation. The Bow River unlike the Oldman River, is a regulated river in which the effects of natural annual floods are dampened by weirs and dams. Thus perennial aquatic plants were well established in the Bow River and were rarely subjected to sufficient scouring for thorough removal. The Oldman River substrate, in contrast, is annually scoured to the extent that bed movement has been documented (Warner, 1973).

Attached algae, unlike macrophytes, are less firmly attached to the substrate and particularly sensitive to physical abrasion. Survival and success, therefore, command that this group of primary producers must grow and reproduce rapidly. Benthic algae have life spans ranging from a few days to weeks.

The rate of growth within the community was highly variable and directly related to the morphological characteristics of the individual community components, as well as to the overlying characteristics of the aquatic habitat. It was this complexity which contributed to the extremes of variation concerning algal standing crops and productivity in the South Saskatchewan River Basin.

During 1980, a "low flow" year, the benthic communities were more productive than during 1981, a "higher flow" year, despite the occurrence of similar standing crops. During 1981, only those species more firmly attached to the substrate overcame physical disruption. However, that type of community proved to be less actively absorbing ^{14}Carbon. During 1981, filamentous green algae such as Cladophora sp. were more abundant than during 1980, and they frequently formed long flowing masses. The development of this type of community resulted in shading and disruption of the less firmly attached matrix of macroalgae and bacteria. This reduced the apparent rate of ^{14}C uptake, and at the same time yielded high chlorophyll a estimates. Moreover, Cladophora sp. accumulated new actively-growing cells on the filament tips and retained fewer actively-growing cells for attachment. Again, this contributed to a high chlorophyll a estimate of algal standing crop (which is not particularly active photosynthetically). Therefore, caution is warranted with respect to the interpretation or classification of lotic systems using any particular assay.

Throughout the South Saskatchewan River Basin the benthic algae and macrophytes underwent distinct temporal maxima. The patterns, although similar throughout the Basin, are moderated by the availability of nutrients, the suitability of bottom substrates, competition and consumption by other organisms, temperature, turbidity and light. The factors that most affected benthic algae and macrophytes were nutrients (orthophosphorus, dissolved nitrogen) and discharge velocity. Physical factors have been shown to override the stimulating effects of nutrient additions upon the primary producers. Under the circumstances, dissolved phosphorus concentrations of 0.060-0.090 $mg \cdot L^{-1}$ failed to produce high macrophyte standing crops. Therefore, the use of critical or growth controlling concentrations of phosphorus at 0.060 $mg \cdot L^{-1}$ (Wong *et al*. 1976) as an indicator of the potential for primary producer growth requires careful interpretation and evaluation when applied to lotic systems.

6.0 SUMMARY

Lotic systems in southern Alberta are precariously balanced ecological systems existing in close proximity to man. During the past 100 years, they have been particularly vulnerable to man's uses and abuses. The rivers range from small crystal clear, (upper Bow River, upper Oldman River) streams that are remarkably uniform in flow and composition, to larger water courses subjected to violent fluctuations in biotic composition, chemical characteristics and discharge.

The middle reaches are enriched by nutrient additions of domestic, industrial and agricultural origin, which stimulate the primary producers. The lower reaches of the Bow, Oldman and the entire South Saskatchewan River are chemically and biologically similar seasonally. Nitrogen is a particularly important, possibly-limiting nutrient in the lower Oldman River. Phosphorus, discharge and temperature are the variables (limiting factors) controlling the development of primary producers throughout the South Saskatchewan River Basin. Physical factors have also been shown to exert a major controlling influence on the primary producers.

6.1 Conclusions

1. The South Saskatchewan River Basin supports a productive, diverse plant association.

2. With the exception of Medicine Hat, plants are most abundant downstream of urban centres.

3. Macrophytes are most abundant downstream of Calgary while algae (epilithic) dominate throughout the remainder of the basin.

4. Primary producer standing crops were highly correlated with phosphorus and nitrogen concentrations.

5. Physical and chemical factors primarily control aquatic plant standing crops in the South Saskatchewan River Basin.

6. The Bow and Oldman rivers exhibit higher standing crops throughout their middle reaches.

7. Primary producers exhibit temporal (annual and daily) fluctuations of primary productivity and standing crop. They are extremely opportunistic and extremely well adapted to the dynamic nature of lotic systems.

7.0 GLOSSARY OF ABBREVIATIONS

ABBREVIATION	DEFINITION
A:M	Algal, Macrophyte ratios
Baci	Bacillariophyta
C	Carbon or Celsius depending on usage
^{14}C	Carbon 14 isotope
Chl	Chlorophyll
Chl a, chl a	Chlorophyll a
Chlor	Chlorophyta
cm	centimeter
cm^2	square centimeter
cm^{-2}	per square centimeter
corr.	correlation
Cyano	Cyanophyta
D	degrees
Dev.	deviation
DIC	dissolved inorganic carbon
disc	discharge
diss	dissolved
DN	dissolved nitrogen
DOC	dissolved organic carbon
DP	dissolved phosphorus
d/s	downstream
dwt	dry weight
EP	epilithic
ft^2	foot squared
g	grams
GF/C	cellulose glass fiber filter
H	helicopter river course survey sites
H^+	Hydrogen ion/s
hr	hour
hr^{-1}	per hour
Hwy.	highway
JTU	Jackson turbidity units
L	left bank of the river
L	litre
L^{-1}	per litre
log	logarithm
M	minutes
m	meter
m^2	square meter
m^{-2}	per square meter
m^{-3}	per cubic meter
$meq \bullet L^{-1}$	milliequivalents per litre
mg	milligram
$\mu mhos \bullet cm^{-1}$	micro mhos per centimeter; for measuring electrical conductance

µg	micrograms
MJ	mega joules; units for measuring light
mL	millilitres
mm	millimeter
MST	Mountain Standard Time
N	nitrogen
n	number of samples or specimens
NFR	non-filterable residue
NFFR	fixed non-filterable residue
No.	number
OMR	Oldman River
OP	ortho phosphorus
P	phosphorus
p	probability of the event not occuring
P.A.R.	photosynthetically available radiation; 460 - 720 nm wavelength
PCA	principle component analysis
pH	concentration of hydrogen ions in pH units
phy	phyto-planktonic
POC	particulate organic carbon
PRO	productivity
R	right bank of the river
r	Pearsons product moment coefficient; measure of linear association
r^2	coefficient of determination; strength of the linear association
S	standard error of the mean
s	second
s^{-1}	per second
S.D.	standard deviation
sec	second
Si	silica, silicates
sp.	species
spp.	species
SPSS	Statistical Package for the Social Sciences
SSR	South Saskatchewan River
std.	standard
STP	sewage treatment plant
T	time
TN	total nitrogen
TP	total phosphorus
u/s	upstream
vs	versus
wt	weight
x	mean of the sample
=	equal to
<=	less than or equal to

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